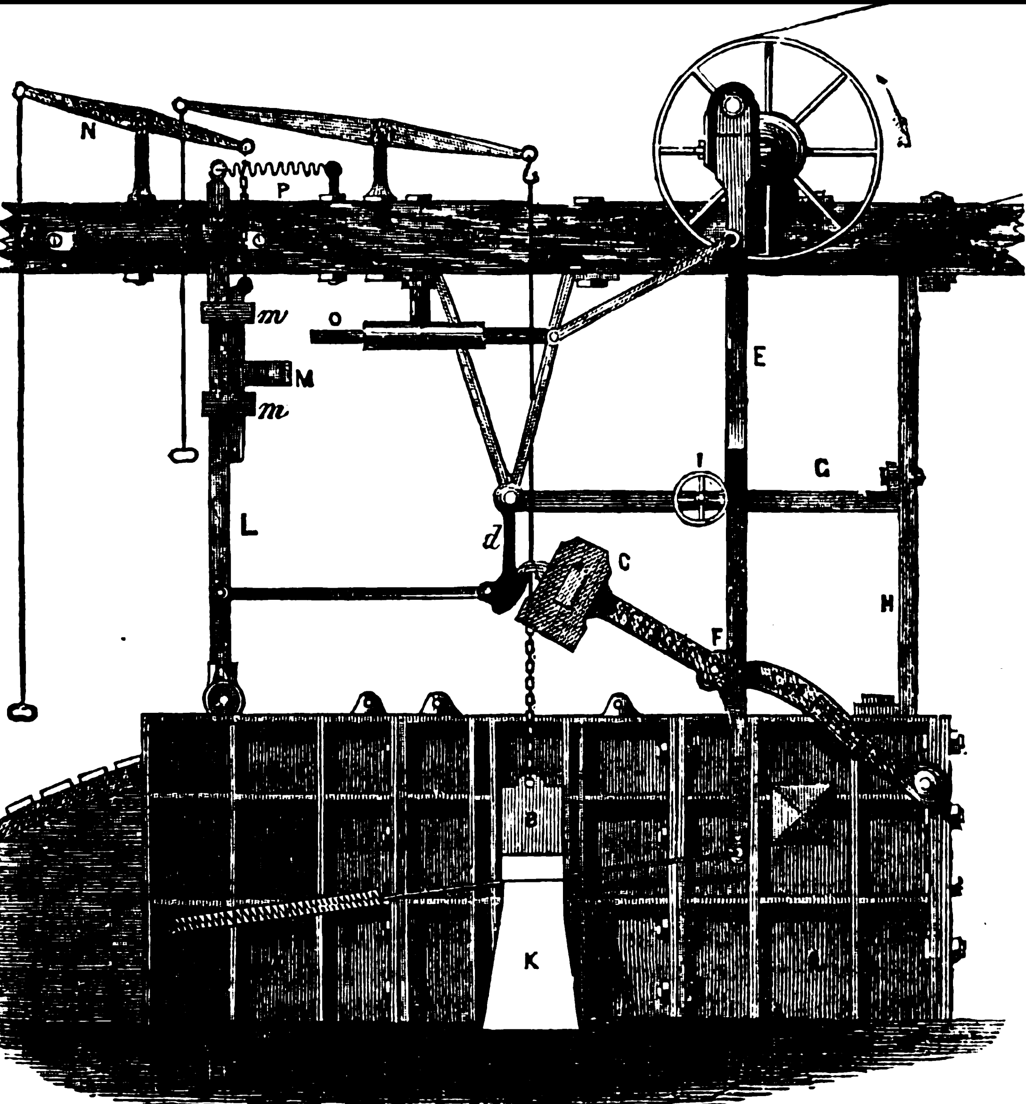

Journal of the Franklin Institute

Franklin Institute (Philadelphia, Pa.)

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OF THE

FRANKLIN INSTITUTE

OF THE

State of Pennsylvania,

FOR THE PROMOTION OF THE MECHANIC ARTS.

DEVOTED TO

Mechanical and Physical Science,

CIVIL ENGINEERING, THE ARTS AND MANUFACTURES,

AND THE RECORDING OF

American and other Patented Inventions.

EDITED BY

JOHN F. FRAZER.

Assisted by the Committee on Publications of the Franklin Institute.

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PROSPECTUS

OF THE

JOURNAL OF THE FRANKLIN INSTITUTE

Of the State of Pennsylvania,

FOR THE PROMOTION OF THE MECHANIC ARTS.

The Journal of the Franklin Institute is the oldest Periodical in the United States devoted to the spread of information on subjects connected with the Mechanic and Manufacturing Arts, and the only one containing a complete record of American Patents issued since its establishment in January, 1826.

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Among its correspondents will be found many of the most distinguished artizans and scientific men of our own Country; and in it will be found the official accounts of many important experimental researches, conducted under authority of the Institute or other public bodies. A liberal compensation is offered by the Committee for all original articles within its scope; and manufacturing firms are respectfully solicited to forward to the Actuary such details as they may deem suitable, of mechanical processes, machinery, steam vessels, and other engineering works in process of construction.

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They therefore propose to forward, *free of postage*, two copies for one year to any present subscriber who shall send the name of one new subscriber, and remit the sum of Eight Dollars. And, in like manner, to forward three copies to any subscriber who shall send the names of two new subscribers and Ten Dollars. A club of new subscribers remitting to the Actuary, Eight Dollars, will be furnished with two copies for one year, and for Ten Dollars three copies for one year.

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FOR THE

PROMOTION OF THE MECHANIC ARTS.

JULY, 1853.

CIVIL ENGINEERING.

Experimental Investigation of the Principles of Locomotive Boilers. By Mr. D. K. Clarke, Edinbro'.*

(Proceedings of the Institution of Civil Engineers, London.)

Continued from Volume xxv, page 365.

By the mode of placing the tube plate some distance within the cylindrical part of the boiler, the tubes were not liable to be choked with cinders, or the draft to be obstructed. This plan also afforded an opportunity of reducing the size of the tubes from 1¾ inch diameter to 1⅜ inch, giving, in the same boiler, an equal area of flue passage, whilst, at the same time, the proportion of tube heating surface was increased 34 per cent. per foot of length of tube, and a very large addition of flame surface was gained.

It was further argued that, although the evaporation of water per pound of fuel was the test of the boiler, yet, up to this time, few, if any, experiments could be implicitly relied upon, owing to the quantities being estimated by the measurement instead of by weight, and without due regard to the variation of the temperature of the water in the tender.

As to the evaporative powers of marine boilers, as compared with that of the best locomotive boilers, if an investigation was instituted, it would be found, that the general features of the best tubular marine boilers now used in ocean navigation were nearly identical with those of locomotive boilers, but the circumstances under which they were used were very

* From the London Artizan, May, 1853.

different. In the marine boilers coal was used instead of coke, and the natural draft of the chimney, instead of the urging of the blast-pipe, in a locomotive; salt water was also used, instead of fresh water, and a pressure of about 12 lbs. or 14 lbs., instead of from 60 lbs. to 80 lbs., on the square inch. Although lightness and compactness were important properties in marine boilers, they were less so than in locomotives; and the former were frequently worked for many weeks or months consecutively, without the means of stopping for any extensive repair, or even to be cleaned, except at long intervals. Under these circumstances marine boilers required to be worked less intensely, and the water and flue spaces must, of necessity, be larger, to prevent, their being choked up.

The following statement showed the comparative proportions and effect of the two descriptions of boilers:—

In the Locomotive Boiler.	In the Marine Boiler.
1 square foot of fire grate consumed about 112 lbs. of coke per hour.	1 square foot of fire grate consumed about 20 lbs. of coal per hour.
1 square foot of fire grate required about 85 square feet of fire box and tube surface.	1 sqare foot of fire grate, required about 30 square feet of fire place and tube surface.
1 square foot of fire grate with the above surface would evaporate 1008 lbs. of water per hour.	1 square foot of fire grate, with the above surface, would evaporate 170 lbs. of water per hour.
1 square foot of flue surface would evaporate 11·7 lbs. of water per hour.	1 square foot of flue surface would evaporate 5·66 lbs. of water per hour.
1 lb. of coke would evaporate 9 lbs. of water.	1 lb. of coal would evaporate 8·5 lbs. of water.
1 H. P. of 33,000 lbs. lifted 1 foot high per minute, required about 4 lbs. of coke per hour.	1 H. P. of 33,000 lbs. lifted 1 foot high per minute, required about 4·25 lbs. of coal per hour.

From this statement it appeared that, although the proportion between the fire grate and the flue surfaces was widely different, the quantity of water evaporated and the power obtained by the consumption of a given weight of fuel were nearly the same, when allowance was made for the difference in the evaporative power of coal and coke.

After explaining the table of "working results," &c., it was contended that, in no case did the formula accord entirely with the practical results recorded in the table; the nearest approximation being that of the "Rocket."

It had been found, in the altered goods engine, that certain practical inconveniences arose from the horizontal transverse water tubes, and two or three mid-feathers had now been substituted for them.

It had been found that intense combustion was liable to cause the formation of clinkers in the small fire box, but which did not occur in the new engine. When the drivers first took out the new engine, being unaccustomed to its peculiar action, they kept thin fires, and drew too much air through the fuel, which was wasted, by raising steam too freely; latterly, the fires had been kept thicker, and the combustion had been slower, whilst the supply of steam had been fully equal to all demands upon the engine, which, it should be recollected, had been built expressly for conveying heavy loads at high speeds, and whose performances, under these circumstances, were contended to have been among the best recorded results of the present day. To set at rest all questions as to duty performed,

it was proposed to institute a set of experiments, or trials, with certain loads at given speeds; the tests to be "consumption of coke per ton per mile, and time of performance." The results to be communicated to the Institution.

The possible maximum evaporative power of 1 lb. of carbon was deduced from the results of chemical experiments, showing that 1 lb. of carbon, converted into carbonic acid, developed 14,000 units of heat, or would raise 14,000 lbs. of water through 1°, which was equivalent to the conversion of 12 lbs. of water at 60° into steam of 120 lbs.

The formula was shown to be derived directly from the tabulated results; it was a mere embodiment of results, and represented no theory.

It was explained that the formula referred to the economical evaporative power of boilers, and that it was in no way designed to limit the unconditional evaporative power; that a boiler might raise less or more steam than the quantity assigned by the formula, but, in the latter case, only by a partial sacrifice of the fuel.

In the comparative trials of the Crewe engines and the new engine with enlarged fire box, it was shown that, looking simply to the boilers, the Crewe boilers raised a greater total quantity of water per hour, and more water per foot of grate per hour, than the new boiler, with greater economy, in the ratio of 8¼ lbs. per pound of coke by the Crewe boiler, to 7¾ lbs. by the new boiler.

It was explained, with respect to the greater time lost by the Crewe engines on the trial, that the defect lay not in the boilers, but in the exposed position and unprotected state of the cylinders, by which steam was condensed; and in the too large size of the chimneys, which should have been only 12 inches, instead of 15 inches diameter; and in the blast pipe, which was carried too far into the chimney.

The formula being applied to the new boiler, indicated that it could not economically evaporate above 120 cubic feet of water per hour; and the correctness of this indication was confirmed by the result of eighteen experiments by Mr. Marshall, as they showed that, though 150 feet of water per hour had been evaporated, it was at a sacrifice of one-fourth of the fuel, as only 7½ lbs. were evaporated per pound of coke.

With respect to the rapidity with which the new form of boiler could get up the steam, and which was attributed to the free draft, it was shown that the "Rocket," the first tube-boiler engine ever made, got up steam in less time than the new boiler.

The benefit of the removal of the tube-ends in the new boiler from the direct action of the fire was considered to be more than balanced by the liability of the lower part of the combustion chamber to become overheated, and to be burned away, owing to the lodging of steam at the junction with the fire box.

It was suggested that, in order to obtain better results from the new engine, the combustion chamber should be abolished, the number of the tubes should be reduced, and their length be extended to the firebox, which should be restricted to 16 square feet of area.

It was further argued that, in the statement of "actual working results," &c., the formula had been misunderstood and wrongly applied; for instance, in the two Crewe engines, of identical proportions, the results of

the formula were stated as 86·2, 84·4, and 73·7, whereas the same results ought to have been applied to each. In No. 291 engine a similar discrepancy was apparent, the results being 116·5 and 102·7.

In the experiments themselves there were several unexplained anomalies, and, in some instances, the engines, instead of working at their full power, were performing very inadequate duty, and, therefore, under circumstances to which the formula was not intended to apply.

In the case of the altered goods engine, No. 125, it was urged that, in its original state, the engine must have been either in a very inefficient condition, or that its duty must have been chiefly confined to piloting, when it would have been consuming the fuel without producing any useful effect, as a consumption of 51 lbs. or 58 lbs. per mile run, with an average train of 115 tons, was out of all proportion.

That the result of the working, after alteration, viz., a consumption of 39 lbs. and 43 lbs. per mile run, with a load of 144 tons, was not favorable, as compared with the performance of a narrow-gauge engine reported on by Mr. D. Gooch in the gauge inquiry, where, with a consumption of 47 lbs. per mile, a load of 294 tons was conveyed: also, when compared with the working of the Eastern Counties goods engines for the last half-year, where, with an average load exceeding 170 tons, the consumption of coke was only 32 lbs. per mile, taken over a distance of 529,000 miles.

A comparison was drawn between the recent experiments, by Mr. Marshall, on the large firebox engine, and those on the long-boiler engine, made during the gauge inquiry, the results being, with the former, a consumption of 40 lbs. per mile with an average load of 64 tons, and, with the latter, a consumption of 27 lbs. per mile with a load of nearly 60 tons.

The recorded results of the passenger trains on the Eastern Counties line, for the last half-year, showed an average consumption of coke under 18 lbs. per mile run.

It was contended that, hitherto, no advantages had resulted from the extension of the fire-box and the reduction of the length of the tubes; still it was possible that this innovation might, by directing attention to the subject, lead to important modifications of the structure of locomotive boilers, which should possess compactness, lightness, power of raising sufficient steam with rapidity for performing the required work, strength to resist the chance of explosions, and a form calculated to diminish the disastrous effects of explosions, when they occurred, facility of repair, especially of the fire-box, which was the part most liable to deterioration, being most severely acted on by the fire, and also requiring more support than the tubes, the latter being, at the same time, cheaper and of thinner metal, whilst, by an extension of their length, the diameter of the external shell of the boiler could be diminished; the fire grate should not be larger than would evaporate the required quantity of water in steam within a given time, with the utmost practical economy of fuel, and, if that were accomplished, it was of little importance whether the evaporating heat was communicated through the fire-box, or by the tube surface.

As to the mid-feathers, it was contended they had, hitherto, only served to extend the dimensions of the fire-box, and to increase the difficulties

of maintaining and repairing the boiler; and that, up to the present time, the results of the experiments upon the boiler, with enlarged fire-box and shortened tubes, exhibited rather a retrograde step, than an onward progressive movement.

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*Harbors of Refuge on the Recoil Principle.**

Mr. W. H. Smith, C. E., the inventor of a new plan for harbours of refuge and defence on the recoil principle, lately explained his principle by working models before the Liverpool Polytechnic Society. He commenced by some general observations as to the high estimation in which harbors were held by ancient nations, and described several defensive works of this description in Rome, in Greece, in Egypt, and elsewhere. The harbor of Syracuse, for instance, was ten miles in extent, and would contain 500 ships, while on the breakwaters were erected temples and ambassadors' residences. Tracing the history of harbors up to modern times, and describing the structure of the defences—chiefly of stone, or huge masses of concrete, he stated that no breakwater yet formed had withstood the tempest. In proof of this, he pointed to Plymouth, Cherbourg, Kingstown, and other places. Even the Bishop Rock Lighthouse, made of cast-iron pillars, was carried away very shortly after its erection. He accounted for the Eddystone Lighthouse standing so firmly by the fact that, owing to the peculiar form of the house, the wave was carried up a beautiful parabolic curve, and its whole weight used to destroy itself; the water being frequently thrown right over the top of the lighthouse. The inventor then dwelt upon the fearful loss of life and property which occurred annually on our coasts, in consequence of the deficiency of harbors, and also from the defects of what harbors we had. He estimated this yearly sacrifice at 1800 human lives exclusive of the fisheries, and 3,000,000*l.* sterling in property. He next reviewed the various modes of forming harbors, the time occupied in their construction, and the large and unnecessary expense attendant upon such undertakings. The design of his invention was to obviate the defects of stone harbors, and to form a protection equally efficient to one-twentieth the cost if of iron, and one-fiftieth the cost if of wood. A small harbor on the recoil principle might be formed of a series of independent open frames or gratings of wood or iron, and be of sufficient depth and capacity to shelter a dozen large ships, at a cost of 8000*l.*; whereas, in stone, it would involve an outlay of about 200,000*l.*

The principle of his invention was clearly and beautifully illustrated by the trumpet-mouthed weed of the Cape of Good Hope (laminaria buxinalis), growing to a height of from 30 to 40 feet, and which formed a natural yielding breakwater, behind which the largest class of vessels could ride securely. The framework, Mr. Smith explained, is secured to the bed of the sea on screw-piles, tied across by iron tie-rods, and the breakwater is intended to be 15 feet above high-water mark. Each timber, or if iron is employed, each angle-iron, is placed the right angle outwards, with an intermediate space of the same width on each side, be-

* From the London Civil Engineer and Architect's Journal, May, 1853.

tween which the divided wave finds its way, and the same with the framing in the rear. The braces are of iron, with a casing of timber, and weighted with heavy iron weights; the ground mooring is lewised into the bed of the sea. The weights are sufficient to keep the sections motionless, except in a storm, when rigidity would endanger their safety; the wave then gradually gives impulse to the section, which drifts as the weights are lifted to the extent of a few feet, as even a solid body, like a ship or a cask, would only be driven about 10 feet to leeward by one wave. The moorings, now released, have absorbed and measured the total pressure of the wave, and spring back with their full reactive force to their original vertical position: the back framing of the section, as it recoils, completely disseminates any remaining wave. Each section being separate from the adjoining one, has an entirely independent play before the vermicular section of the sea.

Mr. Smith concluded by pointing out the economy of his invention, the freedom from silting, the facility of removal, and other advantages which it possessed. The plan has already been laid before the Liverpool Dock Trust, the Chamber of Commerce, and many of the principal literary and scientific societies and associate bodies in different parts of the kingdom.

On Color Blindness in Connexion with the Employment of Colored Signals on Railways. By George Wilson.*

In the number of your Journal for the 29th of January, 1853, Mr. W. H. Tyndall has drawn attention to the important fact, that the *red* and *green* danger signals employed on our railways, when *seen together* in certain circumstances, may be, and on actual trial were, mistaken for *white*—the safety signal.

He also observes, that "it is not improbable that some of the accidents which have occurred in railway traveling have arisen from the colors of the lights shown being indistinctly seen; perhaps from a confusion of rays from two or more lamps. In some cases most contradictory evidence has been given as to the color of the signal shown." Few, probably, will dispute the justice of Mr. Tyndall's conclusion; but there is a source of danger connected with the use of colored signals, by day as well as by night, not referred to by him,—probably of more importance than that which he has indicated, and, at all events, of sufficient importance to demand notice at a period when railway accidents have been unusually frequent.

It has long been known that certain persons cannot distinguish colors from each other; and considerable interest has been felt in this form of depraved vision since Dalton, in whom it occurred, published the particulars of his case. Under the title of Daltonism, *Chromatopseudopsis*, or color blindness, the peculiarity of sight in question has been referred to by different writers. Those who are curious in the matter will find the subject fully discussed in a 'Memoir on Daltonism, or Color Blindness,'

* From the London Athenæum for April, 1853.

by Prof. Wartmann, in Taylor's 'Scientific Memoirs,' Vol. IV. 1846,— to which the English editor has added some valuable notes.

My present object is, to draw attention to three practical relations of color blindness, namely,—

1. That the affection is much more prevalent than is generally imagined.

2. That red and green, the colors used for danger-signals on our railways, are exactly those which are most frequently confounded with each other by the subject of color blindness.

3. That color blindness implies not merely a confusion in distinguishing between two or more colors, but, at least in many cases, an imperfect appreciation or feeble hold of color altogether as a quality of bodies.

24, *Brown Square*, *Edinburgh*, *March* 28.

On Railway Accidents from 1840 *to* 1852 *inclusive.* By F. G. P. Neison, Esquire.*

The author adopted a classification of twelve principal causes of accident, six of which were assigned to circumstances over which the respective companies had no direct or certain control, and the other six to causes which fell directly under their control. The deaths from collisions and from trains running off the line, which constituted a large portion of the whole, had diminished 35 per cent. since 1840; while the deaths occasioned by passengers jumping from the trains in motion, as well as from mounting trains in motion, had increased 123 per cent. in the same period. The subjoined table shows the per centage of deaths from causes *under* the control of companies and *beyond* their control respectively.—

Causes.	1840–43. Pr ct. of total.	1844–47. Pr ct. of total.	1848–51. Pr ct. of total.
Beyond control of Companies . .	37·50	48·44	56·84
Under " "	62·50	51·56	43·16

Thus it appeared that among passengers the deaths from accidents due to causes "beyond" the control of companies had *increased* no less than 50 per cent. during the last twelve years,—while, on the contrary, deaths from causes "under" the control of companies had *decreased* 30 per cent.; these results, taken with the fact that the number killed from all causes had decreased from 1 in a million in 1840 to 1 in 2½ millions in 1851, proved that means and influences were actively at work which were increasing the safety of life, and that accidents would become yearly less and less in ratio to the traffic, in spite of the increasing carelessness of passengers, as shown by the large increase of deaths from causes under their control. In respect to injuries, the number had declined from 1 in 220,000 passengers in 1840, to 1 in 336,000 in 1851; and they differed from the deaths inasmuch as that 13¼ per cent. only of the accidents which occasioned them were attributed to causes within the control of the passenger. Hence it was argued that the tendency of accidents arising from details of management was to inflict bodily injury rather than occasion

* From the London Athenæum, April, 1853.

death; for while among accidents due to causes within the influence of the passengers themselves, 55 deaths take place for every 100 injuries, 11 deaths only occur to 100 injuries arising from accidents beyond the control of passengers. The author stated that during the years 1844-51 7,044,469,484 miles had been traveled by passengers, and 176 deaths had happened through accidents from all causes,—hence one passenger had been killed for every 40,025,395 miles traveled; supposing, therefore, a person to travel twelve hours per diem at the rate of 20 miles an hour, including the stoppages, for each of the 365 days in the year, he would be killed by an accident in 456 years. In respect to fares, first-class passengers were charged the minimum scale of fares in 1846, but for second and third-class passengers the minimum charges were in 1847. Until these dates the charges had gradually and uniformly decreased, but since then they had fluctuated at a somewhat higher price, and had recently shown a tendency to increase. The average distance traveled by the passengers of each class had become yearly less and less, and in 1852 stood thus:—first class, 26$\frac{3}{8}$ miles; second class, 15$\frac{1}{8}$ miles; third class, 10 miles; parliamentary class, 16 miles; all classes, 15$\frac{4}{8}$ miles. The author illustrated the subject by a variety of elaborate calculations, and gave their results in tables.

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*Midland Railway.—The Bursting of a Locomotive.**

An accident occurred on Friday evening, the 7th, about 2½ miles from Bristol, on the Midland line to Gloucester and Birmingham, of a very unusual kind. One of two engines which were drawing a goods train, on the train coming to a stand still through the greasiness of the rails, suddenly exploded. Happily the two men driving it were off the engine, endeavoring to prevent the train running back by the application of sprays to the wheels of the tender.

An occurrence of this kind, the explosion of a locomotive, is exceedingly rare. We doubt if there have been anything like half-a-dozen explosions since railways commenced. They commonly give way in the tubes, the weakest part, and save the body of the boiler.

It will be remembered that a few weeks ago we gave a caution, and repeated it, of the excessive pressure now used in the boilers. Eight or ten years back 55 or 60 lbs. to the inch, above the atmosphere, were the ordinary pressures of the steam, except where great lap to the valve, and working expansively, were used. Then the pressures rose to 80, and occasionally to 85 lbs. to the inch. Now, however, the men apply, for the purpose of running a little more economically in coke, a pressure as much as 200, and nearly 300 lbs. to the square inch. Such pressures as those are dangerous in the extreme. We must, however, do the Directors the justice to observe that we believe it is generally unknown to them. What the pressure in the Midland locomotive was we do not know, and perhaps it never will be known, but the fact of the explosion should call the attention of all railway Companies immediately to the perilous practice existing. It is enough surely for travelers to have the risk of collisions, breakages, running off the rails, &c., without subjecting them, for the

* From Herapath's Journal, January, 1853.

saving of a little coke, to be blown to atoms. The explosion of the Midland boiler has happily passed off harmlessly, but another may not do so, and if it should not, it will scarcely be so mild an affair as just frightening the passengers with a report and have done.

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*Traffic on Railways in the United Kingdom of Great Britain.**

It appears from a return just issued by the Board of Trade, that 39,249,-605½ passengers were conveyed upon all the railways in the United Kingdom during the half-year ending 30th June, 1852. Of these 4,669,-356 were first-class; 14,357,197, second class; 6,255,740, third class; 14,052,340, parliamentary class; and 14,972, periodical ticket class. The receipts being respectively £1,011,707, £1,288,294, £254,952, £782,513, and £58,556, making the total receipts for passengers £3,-403,824, including £7,800 for excess fares. The receipts for goods, cattle, parcels, mails, &c., amounted to £3,791,726; total receipts from all sources of traffic, £7,195,551.

The total receipts for conveying 37,881,703½ passengers during the corresponding period of 1851, amounted to £3,359,937, and for goods, cattle, parcels, mails, &c., to £3,389,585; total from all sources, £6,-749,522, showing an increase of 1,367,902 in the number of passengers, and of £446,029 in the receipts in favor of the half-year ending June 30, 1852.

Of the £7,195,551 received in the United Kingdom, the sum of £6,-168,313 was received on railways in England and Wales, against £5,825,-242 at the corresponding period of 1851; £718,675 on railways in Scotland, against £663,925; and £308,569 on railways in Ireland, against £260,354 in the corresponding period of 1851. Of the 39,249,605½ passengers conveyed during the half year ending June 30, 1852, 32,-682,415½ were conveyed on railways in England and Wales, against 30,883,566 at the corresponding period of 1851; 3,905,724 on railways in Scotland, against 4,333,135½; and 2,661,466 on railways in Ireland, against 2,665,002 at the corresponding period of 1851, showing an increase of 1,798,849 in the number of passengers conveyed on railways in England and Wales, and a decrease of 427,411 in the number conveyed on railways in Scotland, and of 4,536 in the number on railways in Ireland as compared with the corresponding period of 1851. The aggregate length of railway open for traffic in England and Wales at the end of June, 1852, was 5434 miles against 5200 miles open at the corresponding period of 1851, 962 miles in Scotland against 961; and 680 miles in Ireland, against 537 miles; making the total length of railway open for traffic, 7076 miles against 6698 miles open at the corresponding period of 1851.

* From Herapath's Journal, No. 732.

LAW REPORTS OF PATENT CASES.

For the Journal of the Franklin Institute.

Fire Proof Safe Case.

In the Circuit Court of the United States for the Western District of Pennsylvania. — Crandale Rich & Co., *vs.* Lippincott & Barr.

This was a suit brought by the plaintiffs as assignees of Daniel Fitzgerald, to recover damages for the infringement of letters patent* granted to Fitzgerald, June 1st, 1843, for an improvement in iron safes. It was tried at Pittsburgh before Mr. Justice Grier and a jury, in May last.

Messrs. Seth P. Staples and A. W. Loomis appeared for plaintiffs; Messrs. Shaler, Stanton, and Umbstetter appeared for defendants.

The case was one of much interest, both from the reputed value of the patent right, the damages claimed in this case, and from the previous litigation that had taken place in New York and Boston under the same patent. In a suit tried before Judge Nelson at New York, in the year 1848, a verdict was found sustaining the validity of the patent. In that case, for the first time in this country, the doctrine was announced that if a new machine or art had been previously known, and had been afterwards entirely lost sight of and forgotten, and the memory of the old machine or art had passed away, such a prior knowledge would not invalidate a subsequent patent obtained by one who had discovered anew the same art or machine. This view was adopted by Judge Nelson in his charge to the Jury on the trial of that cause, who thereupon found a verdict in favor of the patent, and the same view was afterwards sanctioned by the Supreme Court of the United States.

Justices McLean, Daniels, and Grier, dissented from the opinion delivered by the Court. The peculiar state of the facts on which that question came before the Jury in New York, and before the Supreme Court, was this:

It appeared that James Conner, who carried on the business of a stereotype founder in the city of New York, made a safe for his own use

* We give below an abstract of the Specification of Fitzgerald's Patent, describing his invention in his own words. The improvement is known as the Salamander Safe.

"I take two iron chests, in the common and ordinary way of making iron safes, which is well known to those engaged in this branch of business; one smaller than the other, which, when the safe is put together, forms the inner chest or inner part of the safe. The other chest is made about three inches larger than the inner one, and so as, when put together, it will form the outer part or crust of the safe, and leave a space between the inner and outer chests of the safe of about three inches; which space may vary a little, more or less, when the chests are put together, but should be the same all around and in every direction. The inner and outer doors, when two doors are used, are prepared in the same way, leaving a space, as above, between the inner and outer crust of each door, which space is left for a like purpose with that left between the inner and outer chest of the safe. Where one door is used, it should be made in the same manner, leaving a space between the inner and outer crust or face of the door, and for a like purpose, and should be fitted to the chest or safe with great accuracy. The edges and openings for the doors are to be neatly finished, as in other chests. I then take plaster of paris or gypsum, and

between the years 1829 and 1832, in which plaster of paris was employed as a non-conductor, for the protection of his papers against fire; and that he continued to use this safe until 1838, when it passed into other hands. It was kept in his counting-room, and known to the persons engaged in the foundry; and after it passed out of his hands, he used others of a different construction.

It did not appear from the evidence in New York, what became of this safe afterwards. And there was nothing in the testimony from which it could have been inferred that its mode of construction was known to the person into whose possession it fell, or that any value was attached to it as a place of security for papers against fire, or that it was ever used for that purpose.

Upon these facts the Court instructed the jury, that "if Conner had not made his discovery public, but had used it simply for his own private purpose, and it had been finally forgotten or abandoned, such a discovery and use would be no obstacle to the taking out of a patent by Fitzgerald, or those claiming under him, if he was an original, though not the first, inventor or discoverer."

In delivering the opinion of the Court, Chief Justice Taney compared Fitzgerald's discovery to the discovery of one of the lost arts. "It is well known," he said, "that centuries ago discoveries were made in certain arts, the fruits of which have come down to us, but the means by which the work was accomplished are at this day unknown. The knowledge has been lost for ages. Yet it would hardly be doubted, if any one now discovered an art thus lost, and it was a useful improvement, that, upon a fair construction of the act of Congress, he would be entitled to a patent. Yet he would not literally be the first and original inventor; but he would be the first to confer on the public the benefit of the invention. He would discover what is unknown, and communicate knowledge which the public had not the means of obtaining without his invention. Upon the same principle and upon the same rule of construction, we think that Fitzgerald must be regarded as the first and original inventor of the safe in question. The case, as to this point, admits that, although Conner's safe had been kept and used for years, yet no test had been applied to it, and its capacity for resisting heat was not known. There was no evidence to show that any particular value was attached to it after it passed from his possession, or that it was ever afterwards used as

having boiled it or baked it in an oven, and calcined it and reduced it to a powder, I mix it with water till it is about the consistency of cream or thin paste, so fluid as that it may readily be poured into the space left as above to receive it; and I then fill all the space with the plaster of paris, putting in some sheets of mica between the inner and outer chest, to aid if necessary in checking the progress of the heat. * * *

"The above composition or preparation of gypsum may be mixed with several other articles, not contrary to its nature, with a view to increase its efficacy in resisting the action of fire; but from my experience, I doubt if they have much effect. * * *

"The chemical properties of this article are such that by the application of intense heat, it imparts a vapor or gas, or some other properties, which effectually stay the progress of the fire, and arrest the influence and effects of the heat. * * * *

"I therefore claim as my discovery and invention and improvement, the application and use of plaster of paris or gypsum, in its raw state, or prepared as above, either alone or with mica, in the construction of all iron chests or safes, in the manner above described, or in any other manner substantially the same."

a place of security for papers; and it appeared that he himself did not attempt to make another like the one he is supposed to have invented, but used a different one. And upon this state of the evidence the Court put it to the jury to say whether this safe had been finally forgotten or abandoned before Fitzgerald's invention, and whether he was the original inventor of the safe for which he obtained the patent; directing them, if they found these two facts, that their verdict must be for the plaintiff. We think there is no error in this instruction. For if the Conner safe had passed away from the memory of Conner himself and of those who had seen it, and the safe itself had disappeared, the knowledge of the improvement was as completely lost as if it had never been discovered. The public could derive no benefit from it until it was discovered by another inventor. And if Fitzgerald made his discovery by his own efforts, without any knowledge of Conner's, he invented an improvement that was then new, and at that time unknown, and it was not the less new and unknown because Conner's safe was recalled to his memory by the success of Fitzgerald's."

This was the principal question presented in the case as tried at New York, and as argued before the Supreme Court. See 10 *Howard*, 477.

In the present case much light was thrown upon that question by the production on both sides, of very full testimony in reference to the nature and extent of Conner's prior use. The relative merits of Fitzgerald and Conner as inventors, were more fully investigated in this case than had been heretofore done, and the precise extent to which the manufacture of Conner had been carried was brought before the Court and Jury. In instructing the Jury as to the principle of law involved in this question, Mr. Justice Grier adopted and cited the decision of the Supreme Court above referred to, and left the application of that principle to the particular facts developed as at this trial, to the Jury.

Several other important questions of fact arose in the course of the trial, and much testimony was introduced. The following, however, were the points of defence chiefly relied on:

First, That the composition used by the defendants was not an infringement of Fitzgerald's patent, because the patent covered only the use of "plaster alone," or "plaster in combination with mica."

Upon this point it was shown that the defendants had for several years been largely engaged in manufacturing and selling iron safes, which were filled in between the linings with a composition of various materials, of which plaster of paris formed only about one-third part.

Second, That Fitzgerald was not the first inventor; but that plaster of paris had been known and used as a non-conductor of heat long before Fitzgerald's discovery; that it had been used in 1832 by James Conner, of New York, in the construction of a fire proof safe.

Third, That Fitzgerald had suffered iron safes filled with plaster on the plan of his patent, to be publicly sold and used more than two years before the date of his application for a patent, and had thereby abandoned his right to a patent.

Upon this point the plaintiffs relied upon the testimony of Fitzgerald and other witnesses, to show that Fitzgerald had directed his attention to plaster of paris, and made experiments as to its non-conducting qualities

as early as 1830; that he made a model and tested its merits in 1832; and having proved it by public exhibition in New York and Boston, applied for a patent in April, 1836, and continued the application, notwithstanding much resistance by the patent office, until it was finally granted in 1843. That before his discovery the qualities of plaster, as a valuable non-conductor for fire proof safes, was unknown; and that from 1836 until 1843, his application for a patent had been continued.

The defendants submitted the records of the patent office and other evidence to show that Fitzgerald's application for a patent in 1836 was for a combination of plaster with isinglass, saltpetre, and potash, which was rejected by the patent office; and that the application for his present patent was not made until 1839, and in the meantime he had engaged in the public manufacture and sale of safes, and suffered others to do so without any objection, ever since 1836.

Mr. Justice Grier charged the Jury as follows:

Gentlemen of the Jury:—The cases you are sworn to try are two actions between the same parties, brought for an infringement of the same patent. The questions involved in each are the same. They have been consolidated and tried as one action. But in case you assess damages for the plaintiff, you will have to apportion them to each case.

The plaintiffs claim to be the assignees of a patent granted to Daniel Fitzgerald on the 1st of June, 1843. In April, 1839, previous to the issuing of the patent, Daniel Fitzgerald sold and assigned his inchoate right to his discovery or invention, to Enos Wilder. The assignment, though antecedent to the patent, has been decided to be a valid legal assignment of the invention afterwards patented in the name of the inventor.

Enos Wilder afterwards (September 1st, 1843,) assigned all his right and title to Benjamin G. Wilder, and on the 25th of June, 1847, Benjamin G. Wilder assigned the same (with the exception of New York and the New England States) to Crandle Rich, Almon Ruff, and John G. Stephen, the plaintiffs in the case.

The patent purports to be "for an improvement in fire proof chests and safes."

It is important that you note particularly the claim as stated in the specification of what the patentee specially sets forth as his peculiar invention. The law for good reasons requires this to be set forth precisely and specifically, and precludes the patentee from alleging it to be different or more enlarged than he has thus set it forth. It is in these words:

"I therefore claim as my discovery and invention and improvement, the application and use of plaster of paris or gypsum in its raw state or prepared as above, either alone or with mica, in the construction of iron chests or safes in the manner above described or in any other manner substantially the same."

If the plaintiff be the first and original inventor or discoverer of the application and use of plaster of paris to this purpose, and this application produce a new and useful result, it cannot be doubted that it is the proper subject of a patent. It is not for the discovery of the fact or principle that the gypsum has certain qualities not before known, to wit, that it was a non-conductor of heat, but it is for the application of this substance

possessing such qualities, to produce a beneficial result—a manufacture or machine better than any before known.

Assuming for the present, that the patentee is the original inventor of the subject matter of this patent, (for which the patent is prima facie evidence,) and that it is not only a new, but a useful invention, (which is not disputed:)

Your first inquiry will be, has the plaintiff proved to your satisfaction that the defendant has infringed the franchise or monopoly granted by this patent? A question of infringement is one of fact, which it is the province of the jury to decide.

It is impossible for the Court to give you a general or abstract definition of what is an infringement which will be easily applied to every variety of case. "An infringement, is said to take place whenever a party avails himself of the invention of the patentee, without such a variation as will constitute a new discovery." "It may be by making, using, or selling" the thing patented. When the subject matter of the patent is a manufacture, the question will be whether in reality and in substance, the defendant has availed himself of the invention of the patentee; a mere colorable variation in the process or application should not be allowed to protect a defendant.

In order to apply these principles to the present case, you must carefully observe the peculiar nature of the invention, improvement, discovery, or composition of matter claimed in the specification. In the specification the form or proportions of the safe are not claimed, nor the use of one chest within another, nor the idea of interposing a lining of some non-conducting substance between the outer and inner chest to resist the effect of fire. Salt, charcoal, asbestos, soapstone, and perhaps many other substances and compounds have been used for this purpose. If the plaintiff has discovered some substance possessing the requisite qualities for the purpose required, he has a right to patent his invention. But the defendant has an equal right to make or compound any other essentially different composition or substance for the same purpose. But he has no right to avail himself of the plaintiff's invention or discovery by making some colorable alteration in the mode of its application. Now what is the composition of matter which the plaintiff's patent claims to have invented for the purpose of lining chests or safes. It is plaster of paris in the raw state, or calcined or prepared as set forth in the specification, either alone or with mica. Has the defendant used substantially this substance or composition of matter?

Price, the plaintiff's witness, says he furnished the composition used by defendants in making their safes: "*one of his own making;*" that he had used it 25 years, that it contained, not one-third plaster, and many other ingredients.

Now if it be true that the composition of matter sold by witness to defendant was one known and used as a non-conductor for twenty-five years and more, and was not a mere colorable evasion of the plaintiff's patent, taking advantage of his discovery, and merely varying it by a mixture of other ingredients to cover the infringement, even though plaster of paris may have been one of the ingredients of such composition, the use of it is not necessarily an infringement of the plaintiff's patent.

The patentee does not, and could not, claim all compositions known and unknown of which gypsum might be a component part, which might be used as non-conductors in lining safes. He claims gypsum *alone* or with *mica*. If in your opinion the composition used by defendants be substantially the same with that patented, or the defendants have merely varied their composition, to cover the infringement while they obtain the benefit of the plaintiff's discovery, you should find it an infringement. If not, your verdict should be for defendants on this point, and in such case your labors might end here.

2. The next question to be considered (if you find the defendants have infringed the patent,) is whether the patentee is the original and first inventor. As I have said, the patent is prima facie evidence of this, i. e., sufficient till the contrary is shown.

The patent act of 1836, sec. 6, provides, "that any person or persons having discovered or invented any new or useful art or machine, manufacture or composition of matter, or any new or useful improvement on any art, machine, manufacture or composition of matter *not known or used before his or their discovery or invention thereof*," may apply for a patent, &c. The applicant is required "to make oath or affirmation that he does verily *believe that he is the original and first inventor, &c.*, and that he does not know or believe *that the same was ever before known or used.*" The Commissioner is required before he is allowed to grant a patent "to inquire whether the same had been invented or discovered by any other person in this country prior to the alleged invention or discovery thereof by the applicant," &c.

The mere speculation of a philosopher or mechanic, never put into actual practice or operation, will not deprive a subsequent inventor, who has employed his labor and talents in putting it into practice, of the reward due to his ingenuity and enterprise. But, if the first inventor reduced his theory to practice and put his machine or other invention into use, the law never would intend that the greater or less use in which it might be, or the more or less widely the knowledge of its existence might circulate, should constitute the criterion by which to decide upon the validity of any subsequent patent for the invention. A patent may, therefore, be defeated by showing that the thing secured by the patent, had been discovered and put into actual use prior to the discovery of the patentee, however limited the use or knowledge of the prior discovery might have been. (*Bedford vs. Hunt* 1, *Mason* 302.)

If the original inventor of a machine abandons the use of it and does not take out a patent first, no other person can entitle himself to a patent for it. (*Evans* vs. *Eaton* 1, Peters 323). There are exceptions to this general rule, as in case of a lost art, where the knowledge of it has been lost for ages—and in the present case if you should find that Conner discovered this valuable property of plaster of paris before Fitzgerald had put it in practice by lining the interstices of a safe—but that the safe itself had disappeared, and the knowledge of the improvement was completely lost as if it had never been discovered; and Fitzgerald had afterwards made the same invention and discovery anew, his patent might stand. But, if Conner's safe was in existence and in use, and the knowledge of it not entirely forgotten and lost—his omission to bring it into

public use or notice by public exhibitions or experiments would not give Fitzgerald, if he was a posterior inventor, a right to a patent. Conner might have abandoned its use and been ignorant of the extent of its value, yet if his invention was substantially the same with that of Fitzgerald, the latter would not upon that ground be entitled to a patent, provided Conner's safe and its mode of construction were still in the memory of Conner or in the knowledge or use of others before they were recalled by Fitzgerald's patent. (10 *Howard* 498.)

The evidence bearing on this point has been very fully and ably commented on by the counsel. It is for you to apply it to the principles of law announced by the court.

3. If you should find from the evidence that Fitzgerald was the first inventor of the subject matter of the patent—you will then have to consider a third point made by defendants' counsel: viz., Whether Fitzgerald had abandoned his invention to the public before his application for a patent.

A first inventor cannot acquire a good title to a patent if he suffer the thing invented to go into public use or to be publicly sold for use more than two years before he made application for a patent. "By a public use, is meant a use in public, that is to say, if the inventor himself makes and sells the thing to be used by others, or if it is made by one other person only with his knowledge and without objection, before his application for a patent, *a fortiori* if he suffers it to get into general use, it will have been in public use." *Curtis on Patents*, Sec. 279.

This patent issued in 1843; the immediate application on which it was granted was made in 1839; salamander safes had been made and sold from 1835 to 1839, by Fizgerald and others. The affidavit of Fitzgerald filed with the application of 1839 states that he made this invention in 1835. It is contended by plaintiffs that an application was made before the burning of the Patent Office in 1836 and renewed in 1837. Defendants deny that this application was for the invention patented in 1843; but was for an entirely different one, being a composition of salt, saltpetre, plaster, &c., and moreover that this application was abandoned and the money paid returned, and that after Wilder had purchased this claim in 1839; the first application for the invention as now patented was made by Wilder, who in resuscitating the abandoned claim endeavored to connect it with the former abandoned application for a different invention, in order to save it and give validity to his patent. Which of these hypotheses is true, is for you to decide; the testimony, letters, and documents by which the theory of either party is supported are before you.

If you find that the application of 1836 renewed in 1837 was for this same subject matter now patented—and if such application was not withdrawn by Fitzgerald, but the delay was caused by the conduct of the commissioner of patents in refusing to grant the patent for the same invention since patented, then Fitzgerald should not be considered to have abandoned his invention to the public unless he had abandoned it before 1836, which is not contended.

On the contrary, if you believe that the application of 1836 and 1837 was not for the same with that patented, and therefore was refused by the Commissioner, or was withdrawn and abandoned by the applicant,

and continued so until Enos Wilder got up an application for the present patent, and in the meanwhile the invention had gone into public use for more than two years, then you will find this point for the defendants, and they will be entitled to your verdict.

The verdict was found for the defendants.

AMERICAN PATENTS.

List of American Patents which issued from May 17th, to June 7th, 1853, (inclusive,) with Exemplifications by Charles M. Keller, *late Chief Examiner of Patents in the U. S. Patent Office.*

MAY 17, 1853.

29. For an *Improvement in Pendulum Levels;* Thomas A. Chandler, Rockford, Ill.

Claim.—"What I claim as my invention is, the method of supporting the angular journals of the axle of a pendulum indicator, in turning and self-adjusting bearings of similar form to the angular journals, substantially as herein set forth."

30. For an *Improvement in Violins;* Moses Coburn, Savannah, Georgia.

"The nature of this invention consists in making the apertures, or means of communication between the exterior and interior, in the sides, instead of the top; this is to prevent the weakening of the centre of the top, and the consequent impediment to its perfect vibration."

Claim.—"What I claim as my invention is, the apertures in the sides, instead of in the top, substantially as shown and described, for producing the effect set forth in this specification."

31. For an *Improvement in Vertical Pianos;* Edwin Fobes, Boston, Massachusetts.

"My improvement is practically and usefully applicable to the piccolo alone; as were it applied to the long upright, it would cause the position of the straining pins of the strings to be such as to render it impossible for a tuner to obtain access to them while tuning the piano."

Claim.—"What I claim is, the arrangement of the straining pins with their axes vertical, or nearly so, and parallel, or nearly so, to the general plane of the strings, and to stand above the iron frame as set forth; the string of each hitch pin having guide rollers applied to it, substantially as above set forth; my improvement enabling me to obtain sundry important advantages in the construction and tuning of the piccolo piano forte. And I also claim extending the sounding board upwards above the bridge, and in rear of the bridge plate in the treble, and so as to be capable of vibrating in the rear of and above said bridge plate, all substantially as above set forth."

32. For an *Improvement in Umbrellas and Parasols;* Samuel Fox, (near) Sheffield, England; patented in England, April 6, 1852.

Claim.—"Having described my invention, or the manner of performing the same, I would have it understood that I do not claim the bending or corrugating a metallic plate or bar for the purpose of imparting strength thereto; but what I claim is, the improvement in the manufacture of umbrellas and parasols herein described, the same consisting in making them with ribs and stretchers of plate steel bent in the trough-like shape, as specified, in combination with eyes and connexions, applied essentially as described, whereby they are rendered comparatively much lighter than, and still possess all the requisite strength of those made with solid or round rods of metal in the ordinary way, and at the same time the formation of the eyes and connexions is facilitated."

33. For an *Improvement in Sofa Bedsteads;* Lewis L. Gilliland and Joseph R. Wagoner, Dayton, Ohio.

Claim.—"What I claim as new is, the hinged front board, so arranged that by the turning over the seat to convert the apparatus from a sofa into a bed, the front board shall turn down to prevent it from forming a hard ridge under the sacking, which would be

uncomfortable to lie on, and when the seat is turned back again, to reconvert the bed into a sofa, the front board shall be lifted up again by the act of turning the seat back into the proper position, to support the sacking of the seat. Also, the arrangement of the head and foot boards, so that the act of shutting up the bed will depress them, and opening it out will elevate them again, substantially as herein set forth. Also, the arrangement of the turning seat of the sofa, and the sackings of the bed and seat, in such manner that by the turning of the seat to form the bed, the sacking of the latter shall be stretched, substantially as herein set forth."

34. For an *Improvement in Calendar Clocks;* John H. H. Hawes, Ithaca, New York.

Claim.—"What I claim is, causing a calendar clock to supply its own changes for the irregularities in the length of the months, and showing on its dials the exact and no fractional parts of a day, week or month, by means of the combination of the wheel D, having thirty-one divisions, both of which run together, and independently of each other, at intervals on the same arbor, and the lifting pieces, E F, for supplying the necessary changes in the length of the months; the whole being operated by the hook piece, J, substantially in the manner herein described. I also claim, in combination, the wheel P, of several parts, working spring-tight with the wheel *q*, and the catch piece, X, so that the two wheels may move together, and independently of each other, for the purpose of allowing the day of the month indicator to run during the time that the change is taking place from the end of a short month to the beginning of the next month, while the day of the week indicator passes from one day to another in regular succession, substantially as described."

35. For an *Improvement in Cooking Stoves;* Matthaus Heim, Cincinnati, Ohio.

Claim.—"What I claim as new is, the open bottomed space or chamber behind the fire, encircled at sides and top by flue, and closed at the ends by shifting or movable doors, as described, constituting an accessible and well ventilated arrangement for roasting purposes."

36. For *Improvements in Machines for Cutting Wooden Screws;* Abner H. Longley, Lebanon, Indiana.

"The nature of my invention consists of an auger arranged to operate inside of the screw cutting apparatus, or a reducing tool, to make a tenon in front of a screw cutting apparatus, so as to bore the hole, or make the tenon, and cut the screw in it or upon it, at one and the same operation, and thereby save 25 per cent. of the labor required to do the same work by the machines heretofore used for that purpose."

Claim.—"What I claim as my invention is, giving an equal progressive motion to the cutting tools, in combination with a differential rotary motion, for the purpose of cutting the screws at the same time the hole is bored, or the tenon is made, in the manner and for the purposes set forth, substantially as described."

37. For an *Improvement in Upholstering Furniture;* Frederick Mathesius, City of New York.

"The nature of my invention consists in attaching to the edges of the brocatelle, hair cloth, or other material to be used for the outside, or fancy covering of a chair or sofa seat, or any other article to be covered, ligaments or springs, made of india rubber, or any other material equally as elastic, that will give or stretch when required."

Claim.—"What I claim as my invention is, the covering the seats or other parts of upholstered furniture, or other articles and things, by means and with the aid of elastic ligaments, or springs attached to the edges of the covering, and to the frame work of the article covered, in such manner that the outer or fancy covering, however much used or pressed down, upon being relieved from such pressure, will resume and retain an even and smooth surface, using for that purpose india rubber or springs, or any other elastic material which will produce the desired effect, substantially as herein set forth and described."

38. For an *Improvement in Seeding Hoes;* Julius A. Pease, City of New York.

Claim.—"What I claim as new is, the combination and arrangement of a double bladed hoe, with seed box and drop, as before described, for the purpose of planting separate kernels of corn at equal distances apart."

39. For an *Improvement in Pocket Combs;* Wm. J. Thorn, Westbrook, Maine.

Claim.—"What I claim as new is, the manufacture of pocket combs with semi-circular

joints, in combination with strips over-lapping them, substantially in the manner and for the purpose as herein set forth."

40. For an *Improvement in Castors for Furniture;* Wm. W. Wade, Springfield, Mass.

Claim.—"What I claim as my invention is, the arrangement of the male screw on the spindle, in combination with or respect to the arrangement of the female screw in the socket of the socket piece, and to the bearing surfaces of the said parts, substantially as specified or represented, whereby the spindle is not only preserved in the socket piece by the two screws, but allowed freely to rotate when its bearing surface is in contact with the bearing surface of the socket, as described."

41. For an *Improvement in Graduated Cutters for Cloth and other Substances;* Halsey D. Walcott, Boston, Massachusetts.

Claim.—"I claim, in connexion with the cutting knife, the improvement of making the bed to move or rotate transversely, in combination with making the surface of it, which acts in conjunction with the knife, of variable length or lengths, in order by moving or turning the bed around under the knife, different lengths of cut may be produced, substantially as set forth. And I also claim the improvement of combining with the knife and tubular cutter, and a rotary shaft or cylinder placed under them, the two triangular or trapezoidal beds or surfaces, arranged on the shaft or cylinder as described, whereby a cut or button hole may be made of any desirable length, either with or without a hole at one end, as stated."

42. For an *Improvement in Cleansing and Cooling Block Dies in Rivet Machines;* Davis L. Weatherhead, Philadelphia, Pennsylvania.

"My invention and improvement relates to the cooling of closed or block dies, in which rivets are headed and shaped, and consist in expelling therefrom the particles of oxide, cinders, &c., that fall from the article being formed, by means of a current of water, steam, air, or other fluid."

Claim.—"What I claim as my invention is, clearing cinders, scales, and other obstructions from a socket die made in a solid block, for the purpose of heading rivets by forcing in at the closed end of the die, a stream of water that washes out the cinders, &c., every time a rivet is discharged; the inner end of the socket of the die being closed, so that the pressure of the head of water is rendered available for forcing obstructions out of the die, as herein set forth."

43. For an *Improvement in Lime Kilns;* Samuel J. Seely, City of New York; antedated November 17, 1852.

Claim.—"What I claim is, the process herein described, of calcining limestone in a kiln, by the aid of furnaces, and an artificial draft of air through the furnaces and the kiln, maintained by a mechanical blower, substantially as herein set forth. I also claim the combination of a suction blower at the top of the kiln, and a forcing blower at the bottom thereof, substantially as herein set forth. I also claim the method of regulating the production of steam to generate the power for the engine, in proportion to the duty required of it, by setting the steam boiler in the same furnace that supplies the heat for calcining the limestone, substantially as described."

44. For an *Improvement in Track Clearers to Harvesters;* Wm. F. Ketchum, Assignor to Rufus L. Howard, Buffalo, New York.

Claim.—"What I claim is, the scraper or raking board, constructed as described, or in any similar manner, and combined with the rack piece at an angle less than a right angle, substantially as in the manner and for the purpose herein fully set forth."

45. For an *Improvement in Corrugated Plates for Steam Boilers, &c.;* Richard Montgomery, Assignor to Elizabeth Montgomery, City of New York; foreign patent dated February 17, 1853.

Claim.—"What I claim is, the corrugated metal plate as herein described, with flat margins of greater thickness than its middle."

46. For *Improvements in Air Engines;* James A. Woodbury, Winchester, Joshua Merril, Boston, and George Patten, Charlestown, Mass.; patented in England, Jan. 5, 1853.

Claim.—"We claim as our invention the mode substantially as specified, of using air as a motive power; said mode consisting in the employment of a receiver, in which air is to be highly compressed, heated, and maintained at or about a uniform pressure, a suitable

working cylinder and piston, with the ordinary appendages, an air pump or pumps, worked by the engine for supplying the receiver, when the same are connected or combined with suitable devices, as set forth, for cutting off and working the air expansively, and according to the degree of compression of the air; all substantially as herein set forth. We also claim in combination with such an engine, the device for regulating the pressure of the air in the receiver, and economizing the power of the engine; said device consisting of the weighted bar, entering the receiver through a stuffing box, and connected at its opposite end with the stop cocks attached to the chambers of the air pumps, substantially as described, intending to use any known means for accomplishing the two-fold purpose of regulating the pressure of air in the receiver, and opening the pump chambers to the atmosphere, so that the pump shall be relieved from unnecessary labor."

47. For an *Improvement in Seed Planters;* Wm. Cressler, Shippensburg, Pennsylvania.

Claim.—"What I claim therein as new is, in combination with the adjustable tubes, the seeding wheel, with its flanch and partition, for adjusting, receiving, and carrying the grain and other material to be sown with it, around to the opening whence it is conveyed to the ground, as herein fully described and represented."

MAY 24.

48. For *Improvements in Machines for Pulverizing Auriferous Quartz, and Amalgamating the Gold;* Hiram Berdan, City of New York.

Claim.—"What I claim is, 1st, attaching the ball or sphere, obliquely, to the inclined shaft, by the pin, box, and sleeve, substantially as described, in combination with the inclined shaft and inclined bowl, as herein set forth. 2d, In connexion with the said bowl, I claim the heating chamber or furnace, arranged, constructed, and operating in the manner and for the purpose herein specified."

49. For an *Improvement in Gas Burners;* Samuel R. Brick, Philadelphia, Pennsylvania.

"The object of my invention is, to make the flow of gas, at the burning point, uniform and not excessive, notwithstanding a variation of pressure in the main gas pipes, on the combined principles operating in the same successive order, and by the combined means herein set forth."

Claim.—"I do not claim passing the gas through a small long aperture; nor a sudden deflection of it; nor a descent of it; nor any of them together, less than the whole. What I do claim is, the arrangement and combination of the centre conducting pipe, and its capping pipe, inside of the common gas burner, in the manner and for the purpose above described."

50. For an *Improvement in an Engraving Machine;* John B. Blair, Alton Illinois.

"The nature of my invention consists in the arrangement of a machine, so as to be capable of performing the work of a graver, or other tool, to produce either mezzotint or other engraving, with a greater uniformity and regularity than that at present done by hand."

Claim.—"What I claim is, first, the so combining of the needle, whether sharp or blunt, with a pentagraph, or other copying or tracing instrument, through the medium of double carriages, moving at right angles to each other, as that the dots or punctures of said needle may be dispersed or aggregated at pleasure, for the purpose of forming the lights or shadows; the character of the lights and shadows being indicated by a sliding scale moving before the eye, or under the hand of the operator, substantially as described. I also claim the combination and arrangement of the sliding box on the bar, the cords, 15, 17, 19, (the first cord connecting the sliding box with the spring lever, and the two latter connecting the sliding box with the pedal,) and the arm 22, for the purpose of moving by means of the pedal the wheel E,′ towards or from the centre of wheel F,′ on the face of which it works spring tight, to change its motion, and give to the needle a relatively changed motion, substantially as specified. I also claim, in combination with the carriage and needle, the wheel G, with its lifting piece, and the cam wheel, or their equivalents, for changing the character of marks, lines, or dots, upon the plate to be engraved, at pleasure; and this I claim, whether the same be operated in connexion with the pentagraph or not, substantially as described."

51. For an *Improvement in Kettle Bails;* Thomas H. Dodge, Nashua, New Hampshire.

Claim.—"What I claim is, the sliding dovetail or other shaped piece which slides on the bail, in combination with the female dovetail, or other shaped groove cast in the flanch or ear, either on the inside or outside, for keeping the bail permanently fixed in any

position desired, and for any length of time; and, at the same time, admitting of its being left loose, and operating, if desired, like the ordinary swinging bail."

52. For an *Improvement in Radiators for Stoves;* John C. Fletcher, Burlington, Iowa.

Claim.—"What I claim is, the interposition, between the fire chamber and the exit pipe of a stove, of a series of concentric flues, or a spiral flue, so arranged as that the heat of one flue shall pass through the partitions, and in whole or in part be transmitted to the next flue, or portion of the flue, in advance, and prepare it for transmitting the draft through the series, substantially as described."

53. For an *Improvement in Water Metres;* John Hartin, City of New York.

Claim.—"Having described my improved fluid metre, what I claim as my invention is, the adjustable box or stop, in one end of the cylinder, for the piston to strike against, for the purpose of preventing the pin in the arm from straining upon the stop in the slotted arm after the tilting of the lever, substantially as herein set forth."

54. For an *Improvement in the Construction of Harrows;* Lewis Lupton, Winchester, Virginia.

Claim.—"What I claim is, firstly, the constructing the frame of a harrow of double metallic bars, or of flat straps or pieces of metal, and the forming of sockets thereon, by bending the metal, or otherwise, for inserting the teeth or tines, in the manner described, and the uniting the bars or pieces of metal, and the combining therewith, the manner of bracing or staying the same, by the rod and couplings, specifically as set forth. I do not claim the inventing metallic harrows, nor the form thereof; but simply, the improved method of construction, as specified.''

55. For an *Improvement in Meat Cutters;* Stanislas Millet, City of New York.

Claim.—"What I claim is, the combination of a set of revolving knives, or cutters, with the top plate and revolving dish, formed as described, and arranged and operating so as to effect the sub-division of the matter, by the action of the cutters upon it, in passing through the slots in the cover, substantially in the manner set forth."

56. For an *Improvement in Watches and Chronometers;* Thomas Nelson, Troy, N. Y.

Claim.—"What I claim is, the method of constructing watches or chronometers, of any kind, so as to permit the employment of a spring barrel, of a size that shall occupy nearly the entire interior diameter of the watch case or frame, and which I effect by placing the movements upon the top of the barrel, and communicating the motiôn of the barrel to them, by means of a ring, fixed on the interior of the case or frame, with teeth on its inner edge concentric with the barrel, into which teeth the teeth of one or more wheels of the movements may cog or take, substantially as set forth."

57. For an *Improvement in Clover Harvesters;* Jeptha A. Wagener, Pultney, N. Y.

Claim.—"What I claim in the machine for harvesting clover heads without the stalks is, the arrangement of the solid or hollow cylinder, set with knives on its periphery, as described, and just near enough to the fixed knife, or to the concave of the fingers, to admit space enough to allow the clover heads to pass through without being crushed, and so that the combined action of the forward movement of the machine, and the adjustable guard plate, and the knives, the stems may be drawn in and severed close to the heads. 2d, Making the teeth so that they will spring and vibrate towards or from each other, substantially as described.

58. For an *Improvement in Spirit Lamps;* Alexander J. Walker, City of New York.

Claim.—"I do not claim the employment of the inner wick tubes, secured in a stationary bar, and having other tubes sliding over them, which extinguish the light, when the top of the lamp is unscrewed; but what I do claim is, the employment of the plate which serves as a protection against the fluid rising too high, and becoming heated, and exploding; and also as a support for the inner tubes; in combination with the spiral spring and rod, the rod serving to connect the said plate with the top of the lamp, and the spring serving to hold the plate firmly down on the flanch, and also to throw up the cap and extinguishing tubes, instantaneously, after the top has been unscrewed; the whole being constructed, arranged, and operating in the manner described."

59. For an *Improvement in Processes of Distilling Rosin Oil;* Madison Page, Williamsburg, New York, Assignor to Samuel W. Hawes, Chelsea, Massachusetts.

Claim.—"What I claim is, the employment, in the manner and for the purpose de-

scribed, in the manufacture of rosin oils of different qualities, re-distilling the same, and purifying it, substantially as herein set forth, the introduction of the steam into the commencement of the goose neck, above the rosin in the still, so that the vaporized oils from the rosin will pass through and be commingled with said steam, in their passage to the worm for condensation, for the purpose of purification, &c., as set forth."

MAY 31.

60. For an *Improved Door Fastener;* Duncan E. McDougall, Troy, New York.

Claim.—"What I claim as my invention is, combining the two levers, or their equivalents, with the retaining lip plate, claw plate, and set screw, or their equivalents, the said screw serving to operate the levers, and force the plate horizontally against and under the door, and retaining it firmly in that position by means of the same and said levers, in the manner and for the purpose described."

61. For an *Improvement in Cultivators;* Philip H. Keck, Morgantown, Virginia.

Claim.—"What I claim as my invention is, the combination of the balancing pivot with a cultivator, constructed as herein described, for facilitating the turning of the same, as herein specified."

62. For an *Improvement in Compound Rails;* Richard H. Middleton, Alexandria, Va.

Claim.—"What I claim as new is, the combination of the continuous case rail with the split rail, the halves or parts of the latter being constructed with shoulders, that rest on the sides of the case rail, while their lower edges fit into and rest upon the bottom of the same; and the whole being arranged substantially as shown and described."

63. For an *Improvement in Fire Places and Stoves;* Chas. Neer, Troy, New York.

Claim—"Having described the nature of my invention, what I claim therein as new is, the combining with the fire box of a fire place, heating stove or furnace, an inverted pyramidal shaped air chamber, open at top, and suspended over the fire, so that the inclined sides thereof shall radiate the heat and throw it against the fire box plates on all sides; and this I claim, when the fire box is flanked or surrounded by a series of one, two, or more air heating and smoke and gas flues, for the purpose of exposing all the heated plates to the current of air to be warmed and drifted into the room or apartment to be heated, substantially in the manner and for the purpose herein described."

64. For an *Improvement in Bank Locks;* Thomas P. Murphy, City of New York.

Claim.—"What I claim is, 1st, The slides and pins operated in the manner described. 2d, The pressure plate, pressure bolt, and spring attached to the plate, arranged and operating as described, or in any other way substantially the same, for the purpose set forth."

65. For an *Improvement in Grate Bars;* Marie Louise Roucout, Paris, France; patented in France, September 10, 1851.

"The invention consists in constructing the bars of furnaces and other grates, of an arched or partly arched form, with a double row of parallel air holes made in the length of the bars, which, combined with the arrangements described, prevent the clogging of combustible to the bars, greatly improves the combustion, and produces an important economy of fuel."

Claim.—"Having described the nature of my said invention, and the manner of carrying the same into execution, what I claim as my invention is, the construction of bars of furnaces and other grates, of an arched or partly an arched form, provided with two parallel rows of air-holes, substantially as described."

66. For an *Improved Gold Washer and Amalgamator;* Arnold Buffum, Assignor to J. D. Lynde, City of New York.

Claim.—"What I claim as my invention is, 1st, The furnishing of the centripetal discharging compartment, with a horizontally revolving, water moving, and ore guiding table, in combination with a discharging aperture, surrounded by a conical inclined plane at the centre. 2d, The arrangement of the circular guiding channels with connecting openings, so adjusted as to secure an irregular spiral passage from the periphery to the aperture at the centre. I claim these arrangements for gold separators, whether the centrifugal and centripetal compartments be used in combination, or either of them separately."

67. For an *Improvement in Compositions for a Filter;* Wm. H. Jennison, Assignor to Charles Millington, (now deceased,) and John Jordan, and said Millington's Executrix and Executor, and said Jordan, Assignors to James M. Parker, City of N. York.

Claim.—"What I claim is, the combination of animal charcoal, glass, and starch, or its equivalent, treated in the manner set forth, for a filtering composition, as specified."

Re-issue for May, 1853.

1. For an *Improvement in Reaping Machines;* Cyrus H. M'Cormick, Chicago, Illinois; patented October 23, 1847; re-issued May 24, 1853.

Claim.—"What I claim as my invention, as improvements on the reaping machine, secured to me by letters patent bearing date the 21st of June, 1834, and the 31st of January, 1845, is, placing the gearing and crank forward of the driving wheel, for protection from dirt, &c., and thus carrying the driving wheel further back than heretofore, and sufficiently so to balance the rear part of the frame and the rake thereon, when this position of the parts is combined with the sickle back of the axis of motion of the driving wheel, by means of the vibrating lever, substantially as herein described. And I also claim the combination of the reel, for gathering the grain to the cutting apparatus and depositing it on the platform, with the seat or position for the raker, arranged and located as described, or the equivalent thereof, to enable the raker to take the grain from the platform, and deliver and lay it on the ground at the side of the machine, as described."

Designs for May, 1853.

1. For a *Grate Frame;* James L. Jackson, City of New York, May 3.

Claim.—"What I claim is, the combination and arrangement of the figures and ornaments herein represented."

2. For a *Grate Frame;* James L. Jackson, City of New York, May 3.

Claim.—"What I claim is, the combination and arrangement of the figures, flowers, and ornaments herein represented."

3. For a *Grate Frame;* James L. Jackson, Philadelphia, Pennsylvania, May 3.

Claim.—"What I claim is, the combination and arrangement of the figures, flowers, and ornaments herein represented."

4. For a *Grate Frame and Summer Piece;* James L. Jackson, City of N. York, May 3.

Claim.—"What I claim is, the combination and arrangement of the figures, flowers, and ornaments herein represented."

5. For a *Cooking Stove;* Samuel H. Sailor, Assignor to James G. Abbott and Archilus Lawrence, Philadelphia, Pennsylvania, May 10.

Claim.—"What I claim is, the configuration and arrangement of the ornaments in bas-relief, and mouldings on the front plate, side plates, back plate, base plate, oven doors, door and panel, feed doors, draft door, and feet, as fully set forth and described, forming a new and original design for the cook stove, designated as the New World."

6. For a *Cooking Stove;* Julius Holzer, Assignor to James G. Abbot and Archilus Lawrence, Spring Garden, Pennsylvania, May 10.

Claim.—"What I claim is, the configuration and arrangement of the ornaments in bas-relief, and mouldings on the doors, plates, and feet, as fully set forth and described, forming the ornamental design of the cook stove, designated as the Enchantress."

7. For a *Cooking Stove;* Edward F. Robinson, Boston, Massachusetts, May 10.

Claim.—"What is claimed is, the ornamental configuration or design, as exhibited in the drawings."

8. For a *Parlor Stove;* Samuel D. Vose, Albany, New York, May 24.

Claim.—"I claim no separate configuration or parts; but what I do claim is, the combination of mouldings and ornaments, as arranged in the parlor stove, the whole forming an ornamental design."

9. For a *Cooking Stove;* Anthony J. Gallagher and John J. Baker, Philadelphia, Pennsylvania, May 31.

Claim.—"What we claim is, the design and configuration of the ornaments for a cooking stove, as described."

JUNE 7.

1. For an *Improvement in Converting Rotary into Reciprocating Motion;* Henry Baker, Catskill, New York.

Claim.—"I do not claim giving a reciprocating motion to an object, by connecting it alternately to opposite sides of a moving endless belt or chain; but what I claim is, the ring, with its sliding pins, attached to the object to which reciprocating motion is to be given, in combination with the stud, or its equivalent, attached to the endless chain or band, substantially as herein set forth; the points or ends of the said pins being caused to project through to the interior of the ring, to catch the stud, or equivalent, and being withdrawn alternately, to allow it to pass, by springs, levers, and stops, substantially as described."

2. For an *Improvement in Washing Machines;* Thomas A. Dugdale, Richmond, Ind.

Claim.—"What I claim is, combining the wash boards, cords, and floats, substantially as above described."

3. For *Improvements in Propellers;* Henry W. Hewet, City of New York.

Claim.—"I wish it to be understood that I do not limit myself to the mode of construction specified, as other modes of construction may be devised, operating on the same principle, and giving the same action to the paddle, by equivalent means. What I claim is, giving to the paddles, in their circuit, a greater longitudinal than vertical motion, imparted by a crank motion, substantially as specified, in combination with the vibratory motion of a beam or beams, derived from the same crank motion, substantially as and for the purpose specified. And I also claim, in the combination above specified, making the beam or beams slide on the fulcrum or fulcra, substantially as specified, by means of which additional element in the combination, I am enabled to impart to the paddle or paddles the back motion in the direction of the propelling action, during more than the lower half of the crank motion, substantially as specified, and for the purpose set forth."

4. For an *Improvement in Compositions for Treating Wool;* William S. Hubbell and Amos Barrett, Kingsville, Ohio.

Claim.—"We do not confine ourselves to the exact quantity of alcohol and oil, but the quantities we have given work very well; we also do not confine ourselves to the use of pure alcohol, but to alcohol or alcoholic liquors—the pure alcohol, however, if it can be obtained, is to be preferred to any of its mixtures for commercial purposes. Having thus explained our invention, we claim the treating of wool with a composition of oil and alcohol, to prepare and fit it for the several manufacturing operations for which oil has been and is now employed."

5. For an *Improved Door Fastener;* Samuel P. Kittle, Buffalo, New York.

Claim.—"What I claim is, the combination of the bar having the edges with the stop or rest having the lips, constructed and arranged as described. I further claim the combination of the cap with the bar, the effect of the cap being to fill up the space between the edge of the door, when closed, and the casing, as described; all for the purposes and constructed in the manner substantially as set forth."

6. For an *Improvement in Boilers for Cooking Stoves;* R. W. Belson, Philadelphia, Pennsylvania.

Claim.—"What I claim is, the employment of a valve, in combination with the escape tube of culinary boilers; such valve being controlled by the cover, or in any equivalent manner, substantially as herein set forth."

7. For *Improvements in Operating and Locking Knob Bolts;* Oliver Ellsworth, Hartford, Connecticut.

Claim.—"I claim, 1st, The preventer attached to the tumbler of the lock, for the purpose of preventing the bolt being forced inward by means of any instrument from without, as herein described. 2d, I claim, in combination with the pin and spring, the oblique sides or angles, cavity or opening, made in the side of the case of the lock, for purposes already set forth, i. e. for the purpose of converting my lock into a latch, or restoring the connexion between the outer knob and spindle, by means of the rod pin coming in contact with the oblique sides when the inside knob is turned, thereby turning the spindle, and causing the rod pin to be moved out, by reason of the friction of said rod pin upon the sides of said

cavity, as herein set forth. 3d, I claim the introduction of a key through a door or knob, for the purpose of turning the spindle of the lock, thereby causing a lock to be converted into a latch (from the outside), as described. 4th, I claim the thumb pin or disconnecting pin, which pin passes through the outside knob and into the spindle, thereby forming a connexion with the rod, for the purpose of converting the latch into a lock at pleasure, from the outside of a door, as herein set forth."

8. For an *Improved Hose Coupling;* Ralph J. Falconer, Washington, D. C.

Claim.—"I am aware that the draw slide is not a new device in itself, and I do not therefore claim the draw slide as a means of making a tight joint, merely; but I claim the employment of the slide coupling, in combination with the collars of hose, in the manner and for the purpose set forth, by which I am enabled, in the case of water hose, to effect the coupling with the utmost facility while the water is flowing through the hose."

9. For an *Improved Arrangement of Quartz Pulverizer and Gold Amalgamator;* P. G. Gardiner, City of New York.

Claim.—"What I claim is, the arrangement of the vibrating pulverizing basin and amalgamating basin attached thereto, with the screen interposed between the two; said basins being connected to the same shaft, and constructed and operating as described."

10. For an *Improvement in Water Closets;* Herman Goldsmith, City of New York.

Claim.—"What I claim is, the annular water chamber at the upper part of the closet, with a valve, so arranged as to open when the pan or basin closes, and allow a requisite quantity of water to pass around the sides of the pan or basin, and between the sides of the pan or basin and the flanch of the orifice, thus hermetically sealing the orifice, and preventing the escape of effluvia; said valve also closing when the pan or basin is opened, and thus preventing the escape of water from the chamber; the valve being constructed of a sphere or ball, working over a circular opening in the bottom of the water chamber, or constructed in any other manner. It being understood that I do not claim the water chamber, independent of its valve, to operate as above stated."

11. For an *Improvement in Painting on Cloth;* Leon Jarosson, Jersey City, N. Jersey.

Claim.—"What I claim is, the painting upon cloth, previously prepared with the mordant herein described, that will combine, chemically, with colors laid on over the other, and blended by means substantially as described; by which I give great richness to the figures, whilst the tint of each is carefully preserved, and developing and fixing, permanently, the colors, by steam, and restoring the cloth to its natural pliable state, by washing out the excess of coloring matter, substantially in the manner described."

12. For a *Self-Adjusting Platform for Ferry Bridges;* Gerard Sickels, Brooklyn, N. Y

Claim.—"What I claim is, applying or attaching to a ferry bridge, or other boat landing, a movable platform, so arranged with any suitable mechanism as to be operated upon by the boat as it approaches the bridge, in such a manner that the boat causes the platform to move inwards and downwards, when the boat is coming into the slip, and the mechanism or weights herein described, or their equivalents, cause the platform to follow the boat outwards and upwards when the boat is leaving the slip."

13. For an *Improvement in Screw Presses for Packing Boxes;* Geo. W. Wight, N. Y.

Claim.—"I do not claim the cross piece, the form of said cross piece not being novel; nor do I claim the vertical portions of the arms or levers with the hooks on their lower ends, these being common and not new; and I do not claim their combination with the cross piece, which I believe to be in common use; but what I do claim is, the bending of the upper portion of the arms or levers from a vertical position, and tending towards each other, until they reach and are joined to a cross piece or yoke, by joints, at any desired point between the centre of said yoke and the vertical portions of the uprights; thereby giving an oblique or inward direction to the hooks, when the yoke is caused to rise by the operation of a vertical screw."

14. For a *Machine for Boring Rock;* Ebenezer Talbot, Windsor, Connecticut.

Claim.—"What I claim is, the method, substantially as herein described, of applying a rollet cutter or cutters for boring or excavating tunnels and other apertures in rocks or other hard substances, by causing the said rollet cutter or cutters, or sets of rollet cutters, to cut segments of circles from the centre, or near the centre, to the periphery of the tunnel or other excavation, with the concavity towards the machine, in combination with a

motion or motions around the centre of said tunnel, to cause the said cutter or cutters to act in succession on the entire surface to be cut away, substantially as described."

15. For an *Improvement in Artificial Stone;* Julius Hornig and Ludwig Suess, Union Hill, New Jersey.

Claim.—"We do not claim the use of salt for forming a glaze upon pottery wares; but what we do claim is, the mode or process of forming artificial stone, as described; that is to say, we claim the employment of silex, alumina, and salt, mixed and treated substantially in the manner set forth, and in the proportions designated, in the manufacture of artificial stone, meaning by salt, the chloride of sodium, or its equivalent, as set forth in the specification."

16. For an *Improvement in Paper Files;* Hamilton L. Smith, Assignor to H. L. Smith, Cleveland, and Levi Buttles and Henry A. Swift, Ravena, Ohio.

Claim.—"I claim the paper file herein described, with prepared adhesive leaves or margins, as a new article of manufacture."

17. For an *Improvement in Pumps;* L. P. and Wm. F. Dodge, Newburg, New York.

Claim.—"What we claim is, the combination of the cylindrical piston, constructed as herein described, with its valves, and the induction and eduction passages, so that the water all entering said cylinder under pressure, alternately at its ends, and being discharged under pressure through the opening or openings at its side, tends to expand the same, substantially in the manner and for the purpose set forth. We also claim the combination of the piston heads, without the cylinder, with thin valves, and the induction and eduction passages, when these valves are united (to insure simultaneous action), as described, the water entering through the piston heads into the space between the same, and being discharged therefrom through a lateral eduction orifice, the whole being arranged substantially as described; thus dispensing with chambers and partitions in the barrel and valves at the eduction port, preventing leakage, and rendering the pump or engine more simple and effective, and less liable to derangement."

MECHANICS, PHYSICS, AND CHEMISTRY.

Translated for the Journal of the Franklin Institute.

Investigation of the Specific Heats of Elastic Fluids. By M. V. Regnault.

I have been employed for more than twelve years in collecting the elements necessary for the solution of the following general problem:

"A certain quantity of heat being given, what is, theoretically, the moving force which can be obtained from it by applying it to the development and dilatation of different elastic fluids, in the various circumstances which can be realized in practice?"

The complete solution of this problem would give the true theory, not only of the steam engines now in use, but also that of engines in which the vapor of water was replaced by other vapors, or even by a permanent elastic fluid, whose elastic force should be augmented by the heat.

At the time I began these researches, the question appeared to me more simple than it does at present. Starting from ideas then admitted in science, it was easy to define clearly the different elements which compose it, and I imagined processes by aid of which I hoped to succeed, in finding in succession their laws, and fixing their numerical data. But, as usually happens in the sciences of observation, as I proceeded in my studies, the circle continually augmented; the questions which at first seemed to me the most simple, became quite complicated, and, perhaps, I should not have had the courage to attack the subject, if at the beginning I had understood all the difficulties.

It has been admitted until lately, that the quantities of heat disengaged or absorbed by the same elastic fluid were equal, when the fluid passed from the same initial to an identical final state, in whichever direction the transition took place; in a word, it was admitted that the quantities of heat depended only on the initial and final conditions of temperature and pressure, and were independent of the intermediate circumstances through which the fluid passed. S. Carnot published in 1834, under the title of "*Reflections on the Motive Power of Fire*," a work which did not at first excite much attention, and in which he admits, as a principle, that the motive force produced in a fire-engine is due to the passage of the heat from the more heated calorific source which emits the heat, to the cooler condenser which finally collects it.

Mr. Chapeyron has developed mathematically the hypothesis of Carnot, and he has shown that the quantities of heat gained or lost by the same gas, then do not depend solely upon its initial and final state, but also upon the intermediate state through which it is made to pass.

The mechanical theory of heat has regained favor within a few years, and it now employs a great number of mathematicians. But the principle of Carnot has undergone an important modification; it has been admitted that heat may be transformed into mechanical work, and that reciprocally mechanical work may be transformed into heat. In the theory of Carnot, the quantity of heat possessed by the elastic fluid at its entrance into the engine is found entirely in the elastic fluid which issues from it, or in the condenser; the work is done merely by the passage of the heat from the boiler into the condenser, while it traverses the engine. In the new theory, this quantity of heat is not entirely preserved in the form of heat; a portion disappears during its passage through the machine, and the work done is in every case proportional to the quantity of heat lost. Thus, in a steam engine with or without condensation, with or without cut-off, the work done by the machine is proportional to the difference between the quantity of heat which the vapor has at its entrance into the machine, and that which it keeps at the moment of its exit or condensation. In this theory, to obtain the maximum mechanical effect from a given quantity of heat, we must make this loss of heat the greatest possible; that is to say, the elastic force which the expanded steam keeps at the moment of its entrance into the condenser, must be as small as possible. But in every case, in the steam engine, the quantity of heat utilized in mechanical work will be but a very small portion of that which we have been obliged to give to the boiler.

In a steam engine in which the steam is expanded, but not condensed, the steam entering under a pressure of 5 atmospheres, and discharged at atmospheric pressure, the quantity of heat which the steam has, when it enters the machine, is, according to my experiments, about 653 units; that which it retains at its discharge, 637. According to the theory of which I am speaking, the quantity of heat utilized in mechanical work is $653 - 637 = 16$ units; that is, only $\frac{1}{40}$th of the quantity of heat given to the boiler. In a condensing engine, receiving its steam at 5 atmospheres, and the condenser keeping, constantly, an elastic force of 55 min. of mercury, the quantity of heat in the entering steam will be 653 units, and that which it has at the moment of its condensation 619. The heat util-

ized will be 34 units, or a little more than $\frac{1}{20}$th of the heat given to the boiler.

A larger portion of the heat may be utilized in mechanical work, either by overheating the steam before its entrance into the machine, or by lowering as much as possible the temperature of the condenser. But this latter means is hard to realize in practice; it would moreover require a considerable increase in the quantity of cold water necessary for effecting the condensation, which wastes power, and the boiler can only be fed by water which is but little heated. We shall attain the same end more easily by expanding the steam to a less degree in the machine, and condensing the steam by the injection of a very volatile liquid, such as chloroform or ether. The heat which the steam has at the moment of this condensation, and of which but a very small part would have been transformed into mechanical work, passes into the more volatile liquid, which it transforms into vapor of high pressure. By passing this vapor into a second machine, where it expands to the elastic force to which the injection water can practically reduce the condenser, a part of the heat is transformed into mechanical work; and a calculation founded on the numerical data of my experiments, shows that this quantity is much greater than could have been obtained by the further expansion of steam in the first machine. In this way can be perfectly explained, the economical result obtained from two connected machines, the one working with water, the other with ether or chloroform, on which experiments have been recently made.

In the air engines, where the motive force is produced by the dilatation which heat produces upon the gas in the machine, or by the increase which it produces in its elastic force, the work done at each stroke of the piston will always be proportional to the difference of the quantities of heat in the air entering and leaving; that is, to the loss of heat by the air in traversing the machine. But as, in the Ericsson system, the heat which the air gives out, is given up to bodies from which the entering air takes it again, and brings it back to the machine, we see that, theoretically, all the heat expended is utilized for mechanical work; whilst in the best steam engine, the heat utilized in mechanical work is not the $\frac{1}{20}$th part of the heat expended. Be it observed here, that I neglect all the extraneous sources of loss, as well as the mechanical or practical obstacles which may present themselves in the application of the principle.

MM. Joule, Thomson, and Rankine, in England, and MM. Mayer and Clausius, in Germany, starting frequently from different points of view, have developed analytically this mechanical theory of heat, and have sought to deduce from it the laws of all the phenomena relative to elastic fluids. For my own part, I have for a long time expressed in my courses of lectures, analogous ideas, to which I had been led by my experimental labors upon elastic fluids. In these researches, I in fact met anomalies which appeared to me inexplicable in the theories before admitted. To give an idea of them, I will cite some of the most simple examples.

First Example.—1st, A mass of gas under a pressure of 10 atmospheres, enclosed in a space the capacity of which is suddenly doubled; the pressure descends to 5 atmospheres.

2d, Two reservoirs of equal capacity are placed in the same calorimeter; the one is filled with a gas under 10 atmospheres, the second has a complete vacuum. The communication between the two reservoirs is suddenly opened; the gas expands into double its volume, and the pressure is also reduced to 5 atmospheres.

Thus in the two experiments the initial and final conditions of the gas are the same; but this identity of conditions is accompanied by very different calorific results; for, whilst in the first case a considerable cooling is observed, in the second the calorimeter shows not the least change of temperature.

Second Example.—1st, A mass of gas traverses, under atmospheric pressure, a worm, in which it is heated to 100° Cent.; then, a calorimeter, whose initial temperature is 0°. It raises the temperature of the calorimeter t°.

2d, The same mass of gas traverses, under the pressure of 10 atmospheres, the worm, in which it is heated to 100°, then the calorimeter at 0° under the same pressure; it raises the temperature of the calorimeter t'°, and experiment shows that t and t' are but slightly different.

3d, The same mass of gas under the pressure of 10 atmospheres, traverses the worm, in which it is heated to 100°; but when it arrives at the orifice of the calorimeter at 0°, or to any point of its course, the gas dilates, and descends to the pressure of the atmosphere; so that it issues from the calorimeter in equilibrium of temperature with it, and in equilibrium of pressure with the surrounding atmosphere. An elevation of temperature t'' is observed in the calorimeter.

According to the theories formerly admitted, the quantity of heat abandoned by the gas in experiment No. 3, ought to be equal to that of No. 2, diminished by the quantity of heat which has been absorbed by the gas during the enormous dilatation which it has undergone. On the contrary, experiment shows a higher value for t'' than for t' and t. I might multiply these citations, but I should anticipate what I have hereafter to say. I reserve the farther elucidation until I shall publish together the experiments which I have made on the compression and dilatation of gases.

However, the examples which I have just cited suffice to show how careful we must be in the conclusions to be drawn from the experiments in which elastic fluids are in motion, undergo changes of elasticity, and perform mechanical work often difficult to appreciate; for the calorific effects produced depend in great part upon the order and manner in which these changes have taken place.

Unhappily, if it is easy to announce vaguely a physical theory, it is very difficult to specify it with precision, so as not only to connect with it all the facts known to science, but also to deduce from it those which have heretofore escaped observation. The theory of luminous undulations, as it was established heretofore by Fresnel, presents the only example heretofore known in physics. The expression in equations, of the problems of heat looked upon in a mechanical point of view, leads, like all analogous problems, to an equation of partial differences of the second order, between several variables which are unknown functions of each other. These functions represent the true elementary physical laws which

must be known in order to have the complete solution of the problem. The integration of the equation introduces arbitrary functions, the nature of which we must seek to discover by comparing the results given by the equation with those which direct experiments give, and with the laws derived from those experiments. Unhappily, in experiments on heat, direct experiments are rarely applicable to simple phenomena; generally, they attack complex questions, which depend on several of these laws at a time, and most frequently it is difficult to assign the part which belongs to each of them. The experimenter must then endeavor to modify the circumstances under which he operates, so as to vary as far as possible in the respective experiments, the parts which belong to each of the elementary phenomena, and to the law which expresses it. He will thus obtain equations of condition which may be of great aid for the discovery of a general theory; for this, whatever it may be, must always satisfy these equations.

This is the manner in which I have directed my researches, and I have always endeavored to define in the most precise way the conditions under which I was working, so that my experiments might be of service, whatever theory might finally prevail.

I published in 1847, the first part of my researches; they compose the second volume of the *Memoirs of the Academy* (*of Sciences of Paris*). Since that date I have not ceased to pursue them; but the experiments which they required were so numerous, the numerical calculations so long and troublesome, that it would have been impossible for me to have executed them, if I had been left to my own individual efforts. I have been powerfully seconded by M. Izarn, who had already lent me his assistance for the first part of my work, and by a young Engineer of Mines, M. Descos, whom the Minister of Public Works has kindly appointed my assistant for the last two years, in order to hasten the conclusion of my work. Let me be permitted thus publicly to express my thanks for the indefatigable zeal with which they have seconded me.

The subjects to which my new experiments have been directed are the following:

1st, The relations which exist between the temperatures and the elastic forces of a great number of saturated vapors; from the feeblest pressures up to 12 atmospheres.

2d, The elastic forces of these same vapors, saturated or not, in the gases.

3d, The elastic forces at saturation of the vapors produced by mixed liquids.

4th, The latent heat of these vapors under different pressures, from the feeblest up to those of 8 or 10 atmospheres.

5th, The latent heats of vaporization of the same substances, in gases.

6th, The specific heats of permanent gases and vapors under different pressures.

7th, The quantities of heat absorbed and disengaged by the compression and dilatation of gases, whether this dilatation takes place in a space whose capacity is augmented, or whether it takes place through a capillary opening in a thin wall, or by a long capillary tube.

8th, The quantities of heat absorbed by the gas when it produces,

during its expansion, a motive force which is altogether consumed in the interior of the calorimeter, or is principally utilized elsewhere.

9th, And finally, the densities of saturated vapors under different pressures.

The experiments which have reference to these different questions, with the exception of the last one, are now nearly finished. But as much time will still be required to put them in order, and discuss them with the proper care, I propose to present the general results, successively, to the Academy, while awaiting the time when I can publish them together.

I will present at present my researches on the calorific capacities of elastic fluids.

The Capacities for Heat of Elastic Fluids.

The specific heat of elastic fluids may be defined in two different ways; in the first, the specific heat of an elastic fluid is the quantity of heat which must be given to a gas to raise its temperature from 0° to 1° (Cent.), allowing it to dilate freely, so as to preserve a constant elasticity; in the second, it is the quantity of heat which must be given to it, to raise its temperature from 0° to 1°, forcing it to keep its volume, its elastic force increasing.

The first of these has been called the specific heat of a gas under constant pressure; the second, specific heat of a gas under constant volume. The first definition, only, coincides with that which has been admitted for the capacity for heat of solid and liquid bodies; it is also the only one which has heretofore lent itself to direct experimental demonstration.

A great number of physicists have employed themselves during the last century, in the examination of the specific heats of elastic fluids; Crawford, Lavoisier and Laplace, Dalton, Clement and Desormes, De la Roche and Berard, Haycrafft, Gay-Lussac, Dulong, de la Rive, and Marcet, have successively published researches on this subject. The greater part of these physicists have sought to demonstrate experimentally certain laws to which they had been led by the ideas which they had formed *à priori* as to the constitution of elastic fluids. They have applied themselves less to determine the numerical values of the calorific capacities of the different gases in relation to that of liquid water generally taken as unity, than to look for the simple relations which they supposed must exist among themselves. The conclusions to which they have come are generally very erroneous.

The work of De la Roche and Berard, which was crowned by the Academy in 1813, is still the most complete on this subject, and the one whose results differ the least from the truth. This superiority is caused not only by the extreme care which these skilful experimenters exercised in their experiments, but also by the direct method which they followed; whilst the greater part of the other physicists had recourse to indirect methods, in which the element they sought, exercised frequently but a very feeble influence.

The general conclusions which De la Roche and Berard drew from their labors were as follows:

1. The specific heats of the gases are not the same for all, whether we consider them in reference to volumes or to weights.

2. The capacity for heat of atmospheric air (that of water = 1) is 0·2669; that of the vapor of water 0·8470.

3. The specific heat of equal volumes of atmospheric air increases with the density, but in a less rapid progression. The ratio of the pressures being $\frac{1}{1\cdot3583}$, that of the specific heats is $\frac{1}{1\cdot2396}$.

4. De la Roche and Berard admit, on theoretic considerations, and resting moreover on direct experiments of Gay-Lussac, that the specific heat of the gas increases rapidly with the temperature.

These are the most precise notions on the specific heat of gases which we at present possess, and which are generally admitted by physicists. The limits within which I am obliged to confine myself in the present extract, prevent me from discussing the methods which have been adopted by my predecessors, or to explain those which I have myself followed. I will merely say that I have met, in this kind of researches, great difficulties, not only in the experiments, but also in point of theory; the considerations which I have mentioned at the commencement of this article, will render them easily understood. Thus, although my first experiments are fifteen years old, and although I announced them at that epoch in the Memoirs on the specific heats of solids and liquids, it is only after using the most various methods, and after having forced the elements of their correction in opposite directions, that I now, with confidence, present my results to the Academy.

According to my experiments, the specific heat of air compared with that of water, is

Between	— 30°	and + 10° (Cent.)		0·2377
"	+ 10°	" 100°	.	0·2379
"	100°	" 225°	.	0·2376

Thus, contrary to the experiments of Gay-Lussac, the specific heat of air does not vary sensibly with the temperature. Experiments made upon some other permanent gases led to a similar conclusion.

In experiments made upon atmospheric air, under pressures varying from 1 to 10 atmospheres, I found no sensible difference between the quantities of heat which the same mass of gas abandons in cooling, through the same number of degrees. Thus, in contradiction to the experiments of De la Roche and Berard, who found a very notable difference for pressures varying only from 1 to 1·3 atmospheres; the specific heat of the same mass of gas is independent of its density. Experiments made upon several other gases led me to analogous conclusions. I nevertheless present this law with some reserve; I cannot yet decide whether the capacity for heat under different pressures is absolutely constant, or whether it undergoes a very slight variation; because my experiments, perhaps, require a slight correction for the state of motion in which the gas was.

The specific heat 0·237 of the air, compared with water, is notably smaller than the number 0·2669, admitted by De la Roche and Berard; it is derived from more than a hundred determinations made under different conditions.

The other elastic fluids whose specific heat I have determined are:

Simple Gases.	Specific Heats. By Weight.	By Volume.	Densities.
Oxygen,	0·2182	0·2412	1·1056
Azote, (Nitrogen,)	0·2440	0·2370	0·9713
Hydrogen,	3·4046	0·2356	0·0692
Chlorine,	0·1214	0·2962	2·44
Bromine,	0·05518	0·2992	5·39

In casting the eyes over this table, it is immediately remarked that the specific heats of equal volumes of oxygen, azote, and hydrogen, differ very little from each other; so that we would be led to admit that the specific heat of the simple gases is the same, when these gases are taken under the same volume and at the same pressure. But for chlorine and bromine, numbers have been found nearly equal to each other, but much greater than those which were obtained for the other simple gases.

Compound Gases.	Specific Heats. By Weight.	By Volume.	Densities.
Protoxide of Azote,	0·2238	0·3413	1·5250
Deutoxide "	0·2315	0·2406	1·0390
Oxide of Carbon,	0·2479	0·2399	0·9674
Carbonic Acid,	0·2164	0·3308	1·5290
Sulphuret of Carbon,	0·1575	0·4146	2·6325
Sulphurous Acid,	0·1553	0·3489	2·2470
Chlorhydric "	0·1845	0·2302	1·2474
Sulphydric "	0·2423	0·2886	1·1912
Ammonia (Gas,)	0·5080	0·2994	0·5894
Protocarburet of Hydrogen,	0·5929	0·3277	0·5527
Bicarburet of Hydrogen,	0·3694	0·3572	0·9672
Vapor of Water,	0.4750	0·2950	0·6210
" Alcohol,	0·4513	0·7171	1·5890
" Ether,	0·4810	1·2206	2·5563
" Chlorhydric Ether,	0·2737	0·6117	2·2350
" Bromhydric "	0·1816	0·6777	3·7316
" Sulphydric "	0·4005	1·2568	3·1380
" Cyanhydric "	0·4255	0·8293	1·9021
" Chloroform	0·1568	0·8310	5·30
" Dutch liquid	0·2293	0·7911	3·45
" Acetic ether	0·4008	1·2184	3·04
" Acetone	0·4125	0·8341	2·022
" Benzine	0·3754	1·0114	2·6943
" Essence of turpentine	0·5061	2·3776	4·6978
" Chloride of phosphorus	0·1346	0·6386	4·7445
" " Arsenic	0·1122	0·7013	6·2510
" " Silicium	0·1329	0·7788	5·86
" " Tin	0·0939	0·8639	9·2
" " Titanium	0·1263	0·8634	6·836

The specific heat which I have determined for the vapor of water, by a great number of experiments, is 0·475; it is only about one-half of that found by De la Roche and Berard. It is very remarkable that the specific heat of the vapor of water is very nearly equal to that of ice, or solid water, and only one-half of that of liquid water.—*Comptes Rendus de l'Academie des Sciences de Paris*, 18 *Avril*, 1853, *p*. 676.

On the Composition of the Substances employed by the Chinese in the Decoration of Porcelain. By MM. Ebelmen and Salvetat.*

(Continued from Vol. xxv., page 411.)

2. *On the Rough and Prepared Colors.*

The collections of colors examined by the authors nearly always contain the colors both in the rough state and mechanically prepared and fit for use. This mechanical preparation is sometimes the only difference between the rough and prepared colors; in other cases, during the trituration of the substance, a portion of *yuen-feng* or *sy-chy-mo* is added to it; the former when it is desired to render the color more fusible, the latter to produce a contrary effect.

The rough colors are generally irregular glassy fragments, sometimes transparent, sometimes opake. They have all the same color if the color be simple, but possess a varied coloration if the color can only be produced by the mixture of two or more different colors. The proportions in which *yuen-feng* is added to those colors which require its addition, are very various even for the same color. This must, in fact, be the case in a country where all the primitive colors coming from distant districts cannot be prepared by the same manufacturer, and where the temperature to which the paintings are exposed depends entirely on the will of the decorator.

The following may be said of the Chinese porcelain colors in general. They are very slowly dissolved in cold, but readily in hot acids. The solutions contain oxide of lead, alkali, and the coloring oxide. Silica is separated, which, if muriatic or nitromuriatic acids have been employed, is mixed with chloride of lead. The readiness with which they are dissolved varies according to the nature of the coloring oxide.

Moist air acts slowly upon these colors when reduced to a fine powder; by the action of the atmospheric carbonic acid, carbonate of lead is formed, which is dissolved with effervescence by diluted nitric acid.

1. *Whites.*

The Chinese have several kinds of whites, which are distinguished under the denomination of first, second, and third quality, according to their beauty. The authors have examined the following kinds, contained in the collection at Sévres:—

Po-ly-pé, literally glass-white of first quality.

Chang-pé, white of second quality.

Pou-pé, white of third quality.

The other rough (*seng*) and pulverized (*si*) whites appeared to possess exactly the same properties as the above, and were therefore not analyzed by the authors. They are—

Chang-yan-pé, superior European white.

Sué-pé, snow-white of third quality.

Yan-qué-pé, European moon-white.

The last mentioned, which is a white with a slight greenish tinge, is a

* From the London Chemical Gazette, No. 242.

mixture of one of the preceding whites with one of the transparent greens, which will be hereafter referred to.

Seng-po-ly-pé, or white of the first quality, requiring no addition of *yuen-feng*.—This white consists of fragments of various kinds, some opake, others opaline, and others of a grayish bullate appearance. All give a colorless powder. The opacity arises from arsenic acid. Analysis gave—

Moisture,	0·40
Silica,	37·00
Oxide of lead,	44·39
Arsenic acid,	6·00
Alumina,	0·27
Oxide of iron,	0·28
Lime,	0·75
Magnesia,	traces
Potash,	9·50
Soda,	0·05
Oxide of copper,	traces

Seng-chang-pé, or white of second quality, not requiring *yuen-feng*.—It has the same appearance as the preceding, and gave the same elements, but in different proportions. Analysis gave—

Humidity,	0·50
Silica and oxide of tin,	37·50
Oxide of lead,	50·94
Arsenic acid,	5·00
Alumina,	0·15
Oxide of iron,	0·30
Lime,	0·60
Magnesia,	traces
Potash,	3·43
Soda,	0·34
Oxide of copper,	traces

This composition differs greatly from the preceding. The proportion of alkali is only a third of that in the *po-ly-pé* white. The difference however would probably be less if the color were homogeneous; but the substance consists of various fragments, some of which are opake and appear to be richer in lead; the others grayish, and probably containing no arsenic acid.

Seng-pou-pé, or white of third quality.—For use, 1 lb. of it is mixed with 12 oz. of *yuen-feng*. This also contains the opake and opalescent masses described above as constituting the *po-ly-pé;* but they are here intimately mixed with a grayish sandy substance, which appears to be the powder of the stone *sy-chy-mo*, previously mentioned.

The opake fragments contained arsenic acid and 38 per cent. of silica, which agrees with the quantity contained in the *po-ly-pé* and *chang-pé* whites. The grayish powder, isolated as completely as possible from the opake fragments, was analyzed separately by the same processes as those followed in the treatment of the other whites. The analysis gave—

Humidity,	0·25
Silica,	70·60
Oxide of lead,	23·70
Arsenic acid,	1·50
Alumina,	0·42
Oxide of iron,	0·35
Lime,	0·23
Potash,	4·00
Soda,	traces
Oxide of copper,	traces

The composition of the gray powder explains perfectly the custom described by Father Ly, of adding 12 parts of white lead to 16 parts of the compound which he calls *pou-pé*.

Ya-pé, or ivory white, literally tooth white.—The collection of Chinese colors brought by M. Itier contains a specimen of white completely prepared for painting. The authors have analyzed this white. It contains the same constituents as the preceding, except that the alkali is in part replaced by oxide of lead. The composition of this color, which effervesces a little of nitric acid, is as follows:—

Water and carbonic acid,	0·40
Silica,	36·00
Oxide of lead,	54·00
Arsenic acid,	5·60
Oxide of iron,	0·80
Lime and magnesia,	1·20
Potash and soda,	2.00

Arsenic acid appears therefore to be a most important agent in rendering the Chinese colors opake. It would however be a mistake to suppose that the use and properties of oxide of tin are unknown to these people. The authors think that several of the numerous whites, forming part of the collection formed by Mr. Rutherford Alcock, owe their great opacity to tin. They have found the following composition for the white enamel of a vase of Chinese manufacture:—

Silica,	38.00
Oxide of lead,	51·00
Oxide of copper,	traces
Oxide of tin,	10.41
Potash and loss,	0·59

The collection of colors recently sent from China to the Musée Céramique by Mr. Rutherford Alcock, contains several specimens of the above described whites. One of these, it is said, requires an addition of $8\frac{5}{8}$oz., another of $4\frac{1}{2}$, and a third of $2\frac{1}{2}$ oz. of *yuen-feng* to $1\frac{1}{3}$ lb. of color. These various additions correspond with the different fusibilities of the primitive color.

To be Continued.

On Iron, and some Improvements in its Manufacture. By Mr. J. D. Morries Stirling.*

The following remarks will but slightly touch on the ores, chemical composition, and general manufacture of iron; these subjects being greatly too important to be treated of in a communication like the present, and

* From the London Artizan, April, 1852.

requiring much more research and time than the writer can at present devote, even did he feel himself qualified to undertake the task.

It is most desirable that these subjects should be thoroughly studied, as we are certainly more ignorant of the nature and qualities of iron, and of the differences produced by slight modifications in the mode of manufacture, by varieties of fuel, ores, fluxes, &c., than we are of the nature of any other article of manufacture; and it is to be regretted that, in a district like this, where iron manufacture is all-important, so little has as yet been done to elucidate the theory and to improve (on scientific and unerring grounds) the general make of iron, which the writer believes is only to be accomplished by our becoming thoroughly acquainted, as well with the chemical constituents of the various ores, fluxes, &c., as with the changes which these undergo in the various processes of calcining, smelting, refining, and puddling. To do this is probably not in the power of those actively engaged in the making of iron, as their other pursuits would materially interfere with the carrying out the necessarily long series of experiments which would be requisite; and, even could such time be devoted to the pursuit, then we should only have, in all probability, the results of trials made in one district.

There is no doubt that many most valuable improvements have been introduced (more especially of late years) by ironmasters and others connected with the iron trade; but these have chiefly had reference to the later stages and finishing processes in iron making, and to the machinery connected with these processes. Of the chemistry of the blast-furnace, of the changes produced by the process of refining, and in puddling, we are still ignorant. Having devoted a good deal of time to this subject, the writer may be allowed to say, that the more he has studied it, and the more he has seen of iron-making, the more convinced he is of our ignorance; and it is to be hoped that some steps will be taken to improve our knowledge, and render the various processes certain and economical.

The improvements in iron manufacture which are touched on in the following remarks are not of the nature of those alluded to above; they are of an inferior class, and should properly be called improvements in iron, or in the manufacture of certain kinds of iron for certain purposes. It will be unnecessary to enter minutely into the various processes for converting the iron ore into cast and malleable iron, or to describe at length the various materials used.

The chief varieties of iron ore which are used in this country are the clay-band, the black-band, and the hematite. From the hematite the purest pig iron and strongest bar iron are said to be made; and from clay-band a stronger malleable iron is generally supposed to be obtained than from the black-band; but the various qualities can be altered by the judicious ironmaster, and malleable iron of as good quality can be produced from black-band as from the hematite or clay-band. The writer does not here allude to improvement of quality by mixing different ores (by which it is well known the bad qualities of some descriptions are entirely removed), but to the skilful treatment of one or more ores of a somewhat similar character.

The first stage in the manufacture of iron is the conversion of the ore

into cast iron, which is accomplished in various ways. In Great Britain, the ore, after being calcined, if necessary, is introduced, with layers of coal or coke and a flux (usually a carbonate of lime), into a large furnace, and a strong blast (either hot or cold) is urged through the previously kindled mass, to accelerate the combustion of the fuel, and the conversion and fusion of the metal, which is usually tapped from the furnace once in the twelve hours, and run into pigs or ingots, which go by the name of "hot or cold blast iron," according to the nature of the blast employed. The subdivisions of both these sorts of iron are the same, viz., Nos. 1, 2, and 3, when for foundry purposes, and forge or white iron, when intended for being converted into malleable iron; these numbers and qualities of iron are supposed to differ from each other in the quantity of carbon contained in each, although this is doubted by many eminent chemists. No. 1, is certainly darker, softer, and more corbonaceous-looking than the other numbers, and forge or white iron appears to contain much less carbon than any iron intended for foundry purposes; but, as we see a similar effect produced on foundry iron by rapid chilling to that produced in forge iron by the supposed abstraction of carbon, it will, perhaps, be more readily admitted that color is not a test (or at least not a certain one) of the quantity of carbon which iron contains.

It may be here remarked, that the Nos. 1, 2 and 3 give *no real idea* of the nature of the iron; they are relatively comparative, and only indicate the *differences between cast iron of the same district and make;* thus, what is called No. 1 in Wales resembles hard No. 2 in Scotland, and corresponds to Staffordshire No. 2 (average); Welsh No. 2 is fully as hard as Staffordshire No. 3, or Scotch No. 4 (a brand), intermediate between No. 3 and forge iron. As a general rule, Nos. 1 and 2 are adapted for small castings, Nos. 2 and 3 *mixed*, for medium castings, and No. 3, or 3 and 4 in Scotland, or 3 in England, for heavy castings; but the mixtures of Welsh and Scotch, or of Staffordshire, Welsh, and Scotch, are found to make stronger and better castings than those made from one sort of iron.

This mode of producing strong castings has been long practised, and is in many places convenient; and the increase of strength is no doubt satisfactory; but there is still a want of uniformity in result, and an occasional difficulty in keeping to the proportions, and even in obtaining the brands specified by the engineer or architect, or chosen by the founder on his own experience.

It seemed to the writer very desirable, therefore, to obtain, if possible, a kind of iron which should be either uniform and constant in its strength, or, at least, *not under a certain standard*, and, after numerous experiments and trials, he attained this object by making certain mixtures of cast and wrought iron, which have been called "toughened cast iron."

Allusion has already been made to the different numbers of cast iron, and to their qualities; and it ought further to be stated, that No. 1 is considered the weakest, and No. 3 the strongest. To render these uniform in strength, and at the same time to equalize *that of cast iron from different districts*, it is only necessary to vary the quantity of wrought iron introduced, by which means all other mixture is avoided, and so much greater strength insured, as to allow a margin for considerable variation

in strength, from an accidental defect, as well as for a diminution in weight; taking the averages of the toughened cast iron and of the best mixtures.

*Transverse strength of bars, 1 inch square, 4 feet 6 inches between supports.**

Cast iron, average breaking weight	436 lbs.
Toughened cast iron, ditto	733 "

*Tensile strength.**

Cast iron, average breaking weight	7·036 tons.
Toughened cast iron, ditto	11·790 "

*Crushing strength.**

Cast iron, average crushing weight	38·582 tons.
Toughened cast iron, ditto	59·522 "

To render the above more intelligible, the proportions are given below, which have been found to bring very soft Scotch (No. 1 hot-blast) and very hard Welsh (No. 2 cold-blast) to nearly the same strength.

Scotch, No. 1, hot-blast, breaking, when unmixed, at . .	430 lbs.
With a mixture of 33 per cent, of wrought iron scrap, broke at .	713 "
The same Scotch iron as the first, with only 20 per cent. of malleable scrap, broke at about	620 "
Showing a deficiency in the quantity of the scrap.	
Welsh, No. 2, cold-blast, breaking when unmixed, at . . .	440 "
With a mixture of 10 per cent. of wrought iron scrap, broke at .	689 "

The results obtained by Mr. Hodgkinson are very favorable, as shown in the following table, where the breaking weights of common cast iron and toughenened cast iron are given, from the report of the commissioners appointed to inquire into the strength of iron.

Table of Comparative Strength of Cast Iron.

Description of Iron Bars, all two inches square.	Transverse Breaking Load in Centre.	Tensile Breaking Strength.	Crushing Strength.
	lbs.	Tons per inch.	Tons per inch.
Toughened cast iron, with 20 per cent. wrought scrap	2174	11·50	54·64
Low Moor, No. 1	1207	5·67	27·00
Blaenavon, No. 2 . . .	1220	7·46	49·11 / 30·50
Warrington best gun mixture . .	1375	—	—

Comparative trials, on a larger scale, made by Mr. Owen (by command of the Admiralty), give equally satisfactory results. Tensile strength, according to Mr. Owen, 12·50 tons.

Since these experiments and trials were made, the toughened cast iron has been successfully used in the construction of several public works, Windsor bridges, Chelsea Bridge, Yarmouth Bridge, &c., &c.; and it may be mentioned that, by being allowed to reduce the scantling in proportion to the increased strength gained by employing the toughened cast iron, the contractors for the heavy castings of the Manchester viaduct were enabled *profitably to fulfil* their contract, whereas, had they used

* The averages of the transverse and tensile strength are from the experiments of Mr. Hodgkinson, in the government report and elsewhere, and other experimenters; Mr. Hodgkinson is the sole authority for the resistance of crushing force.

common iron, and been confined to the specification, they would have been heavy losers.

For shafting, rolls, pinions, cog wheels, cast iron railway-carriage wheels, cylinders, and other castings where strength and closeness of texture are desirable, the toughened cast iron will be found most useful; also, cast iron, which will not chill in its unmixed state, readily chills with less loss of strength than usual, when mixed in proper proportions with malleable iron.

To insure that the proper proportion of malleable iron is contained in each pig, and also to render the mixture more easily conveyed from place to place, the writer prefers making the mixture at the blast-furnace; and this is done by distributing the proper weight of malleable scrap in the moulds into which the melted iron is to be run. It is thus firmly fixed, and melts more easily and regularly with the cast iron in the cupola or other furnace, the cast and wrought iron heating gradually to the melting point of the former, when the wrought iron is easily acted upon, and fluxed by the cast iron.

The process of converting cast into malleable iron is much more varied than that of converting the ore into cast iron. In some districts a great proportion of the cast iron is refined previous to its conversion; in others little refined iron is used, and in some works cast iron is at once converted into malleable iron; and this latter process seems to be gaining ground.

Refining is, perhaps, the least understood, and the least capable of being explained, of any process connected with iron manufacture. The iron is kept in a fluid state in contact with carbonaceous matter exposed to a blast, and, although it would seem that by such means more carbon *ought to be combined* with the iron, experience shows that a great change is produced in the nature of the metal, and that, as far as we know, the *quantity* of carbon is *diminished*, and the iron rendered more nearly akin to malleable iron, or at least so altered as to be more quickly converted into it.

Refining is an expensive process, great waste of material being unavoidable, but it is still necessary for certain descriptions of iron, and the expense is partly compensated by the greater quickness with which the conversion takes place in the puddling furnace.

Puddling is the last and most important process in the conversion of cast into malleable iron. It is still an extremely rude one, and its theory is not understood; it consists in melting, in a peculiarly constructed air furnace, refined or cast iron, or a mixture of them, and, as soon as the fusion is complete, in continually stirring the melted metal till spicular or granular particles show themselves. Previous to this the melted metal swells up, and what is technically called boils; gas is evolved, and this appears to be the period at which conversion commences: the solid particles increase in quantity, and the whole mass acquires a semi-solidity; the workman keeps collecting the more solid portions and forming them into balls, which become larger and larger, until the whole of the malleable iron is collected, and nothing remains but what is called cinder, in a perfectly fluid state, which is afterwards removed from the furnace by tapping, and again used in certain proportions along with ore in re-

producing cast iron. On the removal of this cinder from the iron, by puddling, squeezing, and rolling, the quality of the resulting wrought iron very much depends.

To avoid the process of refining, to shorten the process of puddling, and to improve the quality of the resulting wrought iron, are, undoubtedly, most desirable. The writer has endeavored to accomplish this, and has reason to believe that partial success has attended his efforts. Instead of using refined iron, a mixture of wrought and cast iron (as already described) is taken, and, after being melted and run into pigs or slabs of the requisite size, it is puddled in the usual way, and the process of puddling is found to be thus so shortened, as to allow of from one to two heats more being brought out, in the course of the twelve hours; the yield is greater, and the quality of the iron is much improved, as regards fibrousness and tensile strength, rendering such iron particularly well adapted for cable iron, tension bars, shaftings, axles, &c., but not for the wearing surfaces of rails, nor for the tires of wheels.

(To be Continued.)

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*Electro-Telegraphic Development.**

The extent of telegraphic communication completed and in operation throughout the world at the beginning of the present year may be estimated, as far as can be gathered from the returns, at nearly 40,000 miles. Of this amount there were nearly 4000 miles in Great Britain, of which 100 miles only were underground, with about 400 or 500 miles in course of construction in England, Scotland, and Ireland, and as many more projected. In America there were 20,000 miles of telegraph completed and in operation, with 10,000 more in process of construction, uniting in one great network the principal cities of the United States, the Atlantic and Pacific Oceans, and the extreme boundaries of that extensive continent. In Europe there were about 11,000 or 12,000 miles of telegraph in operation, and as many more projected or in progress. In Germany there were 3000 miles completed, in Austria 3000, and in Prussia between 3000 and 4000 miles. France, until lately in the rear of other nations, is now extending her telegraphic lines in all directions, her completed mileage at the present moment being small compared with that of other countries, her principal communications being those between London and Paris, Strasburg, and Marseilles. Russia has just commenced her system of telegraphs between St. Petersburg, Moscow, and Cracow, and the ports on the Baltic and Black Seas. In addition to her existing line between Naples and Gaeta, Italy is continuing the Neapolitan line from Terracina to Rome, so as to connect with the lines of Upper Italy. Denmark has about 400 miles of telegraph; Belgium 500, and the Netherlands line has just been completed from Amsterdam to the Hague. About 4000 miles are about to be constructed in India. Switzerland is introducing the instantaneous communicator, as well as other continental cities, so that the only unsupplied portions that will soon present themselves on a telegraphic map of the world will be Australia, Africa, and China.—*Advertiser.*

* From the London Mechanics' Magazine, January, 1853.

For the Journal of the Franklin Institute.

Particulars of the Steamer San Francisco.

New York.—Hull by Wm. H. Webb; machinery by the Morgan Iron Works. The engines and boilers were designed by Mr. Miers Coryell, Engineer of the Morgan Iron Works. Intended service, Pacific Ocean.

Hull.—Length on deck,	286 feet.
Breadth of beam,	41 "
Depth of hold,	16 "
" " to spar deck,	24 "
Length of engine and boiler space,	104 ft. by 15 ft. in width, including passages.
Draft of water at pressure and revolutions, given below,	11 feet 6 inches.
Area of immersed midship section at this draft,	443 square feet.
Capacity of coal bunkers, in tons of coal,	500
Draft of water at load line,	13 feet 6 inches.
Floor timbers at throats, moulded	16 "
do. do. sided,	16 "
Distance of frames apart at centres,	3 "
Masts and rig,	Foretopsail schooner.
Engines.—Two inclined oscillating.	
Diameter of cylinders,	65 inches.
Length of stroke,	8 feet.
Maximum revolutions per minute,	22
Boilers.—Two, round shell and drop flued.	
Length of boilers,	34 "
Breadth of boilers,	13 " 6 inches.
Height of boilers, exclusive of steam chimney,	13 " 6 "
Number of furnaces,	4
Length of grate bars,	7 "
Number of flues,	24
Internal diameter of flues, 1st range 16 inches, 2d range 21½ inches, 3d range 17½ to 15 inches.	
Diameter of smoke pipes, (two,)	4 feet 4 inches,
Height of smoke pipes,	30 "
Maximum pressure of steam in pounds,	20
Description of coal,	Bituminous.
Area of flue and fire surface in boilers,	6000 feet.
Water Wheels.—Feathering.	
Diameter,	28 "
Length of blades,	8 "
Depth of blades,	4 "
Number of blades,	14

Remarks.—The engines have two piston rods each, and connect to one crank pin, dispensing with the centre shaft; are on wrought iron frames. The air pumps are worked by an independent engine; Pirsson's fresh water condenser; air tight fire rooms.

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*Roasting by Gas.**

During the past week, two trials have been made on a large scale of practice, at Greenwich Hospital, under the direction of M. Soyer, the distinguished professor of the gastronomic art, to ascertain the economy of roasting by gas. The experiments were made in the presence of the

* From the London Mechanic's Magazine, March, 1853.

Governor, Sir C. Adam and lady, Sir J. Liddle, M. D., Lieutenant Rouse, General-Superintendent, Lieutenant Monk, and Messrs. Lee and Seville, Inspectors of Works; and the apparatus employed was one constructed by and under the patent of Messrs. Smith and Phillips, of Skinner street, Snow hill; which was noticed in No. 1473 of the *Mechanic's Magazine.*

The first experiment took place on the 8th inst., when thirty-six legs of mutton, weighing together 288 lbs., or on an average 8lbs. each, were roasted at a cost of fourteen pence. This result being conclusive on the general question of economy, it was determined to have a further trial, in order to ascertain the merits of the principle in detail.

The second experiment was tried accordingly on the 11th inst., on which occasion equal weights of mutton were cooked; and the following results were obtained:—Twenty-three joints, weighing 184 lbs., were roasted at a cost of 10½d., with gas supplied at 4s. per 1000 feet. When cooked, the above weight of meat was found to weigh 145 lbs., dripping 19 lbs., and gravy, or osmazome, 2¾ lbs.; thus showing the actual loss to be 18¾ lbs. Twenty-three joints of mutton were also cooked in the usual way, as adopted at the Institution; namely, in one of the Count Rumford's ovens, hitherto considered the most economical. When put in they weighed 184 lbs., when done 132 lbs., dripping 18 lbs., gravy none; thus showing a loss of 34 lbs. The coke consumed in this oven was 102 lbs., coal 30 lbs.—thus proving the great economy of gas over the oven by a saving of 13 lbs. of meat, 1 lb. of dripping, 2¾ lbs. of gravy. The value of the saving is as follows:—Meat, at 6d. per pound, 6s. 6d.; dripping, at 5d. per pound, 5d.; and gravy, at 1s. 6d. per pound, 4s. 1½d.; making a total of 11s. 0½d.

The saving in time and trouble appears still more remarkable; for the gas being lighted, the dome of the apparatus is opened, and the meat put into it, when it is again closed. M. Soyer and every body retires from the kitchen, which is locked up, and allowing two hours and twenty minutes for the cooking, it is found perfectly effected. All the authorities of the hospital present, and the connoisseurs, expressed themselves extremely well pleased at these satisfactory results.

For the Journal of the Franklin Institute.

U. S. Screw Steamship Princeton. By B. F. Isherwood, Chief Engineer U. S. Navy.

Continued from Vol. xxv., page 385.

The Screw as an Auxiliary.—In 1845, May 6th, the *Princeton*, cruising in company with the U. States first class corvettes *St. Marys* and *Saratoga*, and the brig *Porpoise*, the former accounted an extraordinary fast sailer, made a trial for the purpose of ascertaining what pressure of steam, what number of revolutions of the screw, and what weight of coal would be required in addition to her sails, to beat her consorts.

At 9 A. M., started fires in the furnaces and signalled the squadron to make sail. The *St. Marys* and *Saratoga* set royals and steering sails alow and aloft, both sides. At 10 h. 30 m., A. M., all the squadron

were ahead of the *Princeton;* at 10 h. 40 m., started the engines of the *Princeton;* at 11 hs., A. M., passed the *Saratoga* with 8 lbs. of steam, screw making 18 revolutions per minute. Overhauling the *St. Marys,* she being four miles ahead; at 12, M. the *St. Marys* was between two and three miles ahead; at 1 h. 30 m., P. M, the *Princeton* hauled up to speak a ship about six miles distant; overhauled and spoke her, then kept away for the squadron, setting all the port steering sails. At 7 hs. 30 m. P. M., passed the *Saratoga* and *Porpoise,* they being under a press of sail; at 8 hs. 30 m., P. M., passed the *St. Marys,* she having shortened sail.

The following table gives the absolute performance of the *Princeton* during this trial; the engines being much throttled:

Hours.	Steam pressure in boil. in lbs. per sq inch above atmosphere.	Revolutions of the screw per minute.	Pounds of anthracite coal burned per hour.	Speed of the vessel pr hr. in knots of 6082⅔ feet.	Slip of the screw in per cent. of its speed.
11	8	18	4000	5¾	0·17
12	5	17½	2000	7	25·00
1	5	18½	900	7	18·24
2	5	19	900	7	15·14
3	10	26	900	5	39·90
4	6	21	900	5	25·59
5	5	20	276	8	25·00
6	5	20	276	8	25·00
7	13	24	400	8	4·17
8	8	18½	400	8	35·14
9	5	19	none.	7	15·14
10	1	15	none.	5	4·17
Means	6⅓	19·71	912⅔	6·73	0·42

The above trial shows that from 9 A. M., when the engines were started, the consumption of coal was 4 tons and 1992 pounds up to 10 P. M. When the fires were drawn, by which, with the aid of her sails, the *Princeton* was enabled to beat the squadron, the speed of the screw was on an average the same as the speed of the vessel, but (owing to the following current in the wake of the vessel) it was probably giving a considerable propulsive effect.

On May 8th, 1845, a trial was made to ascertain whether the *Princeton,* under sail, would, with the aid of her steam, beat the other ships of the squadron; and whether she could tow the brig *Porpoise* as fast as the others could sail, and at what consumption of fuel. And to determine, also, whether the *St. Marys* or *Saratoga* was the fastest sailer under the circumstances, there being a good royal breeze and smooth water; course steered, W. by N. ¼ N.; Wind, N.

At 11 o'clock A. M., the *St. Marys* and *Saratoga* were abeam of each other; they made sail to royals and flying jib, starboard topmast and topgallant steering sails; the *Porpoise* being a mile ahead and under all sail. The other ships being abeam of each other were ordered to make all sail, and proceed to Galveston, Texas, (about 650 miles distant,) as soon as possible. The *Princeton* remained one mile behind the squadron, when

she made sail, and with 10 pounds of steam, 17½ revolutions of the screw per minute, and 900 pounds of coal per hour, easily beat them all; speed 7 knots per hour; slip of screw, 25 per centum. On passing the *Porpoise*, she took a tow line from that vessel, and commenced the second trial of speed with the other ships.

The *Princeton* took the *Porpoise* in tow at 12 hs. 30 m. P. M., the *Princeton* being under topgallant sails, starboard fore topmast and fore and main topgallant steering sails; the *Porpoise* was under same sail. The *St. Marys* was three miles ahead, and the *Saratoga* one mile and a-half ahead. At 1 h. 50 m. P. M., the *Princeton* was abeam the *Saratogu;* at 3 hs. 35 m. P. M., the *Princeton* was abeam the *St. Marys*, the *Saratoga* being three miles astern and a mile and a half to leeward. At sundown the *St. Marys* was about five miles distant on the lee quarter; the *Saratoga* about nine miles distant; the *St. Marys* about four miles ahead of the *Saratoga.* At daylight the *St Marys* was eight miles distant astern, the *Saratoga* not in sight. At noon the *St. Marys* was twelve miles distant; at sundown out of sight. The mean performance during the towing of the *Porpoise* was as follows, viz: steam pressure in boilers, 10·3 pounds per square inch above atmosphere; revolutions of the screw per minute 27·6; pounds of anthracite coal consumed per hour, 1656; speed of vessel per hour, 8·847 knots; slip of the screw, 0·36 per cent.; maximum speed while towing, 10 knots; minimum speed while towing, 8 knots per hour.

On the 17th June, 1846, a short race was tried between the *Princeton* and the U. S. brig *Somers*, a vessel considered to be a very fast sailer. The brig was under all sail, from royals to courses; the *Princeton* was under similar sail, except topgallants, royals, and flying jib. Both vessels were close hauled, and standing on the same tack, separated by only a few hundred yards; the sea was perfectly smooth, and the wind a fine working topgallant breeze.

After speaking the brig, she stood off under all sail; the *Princeton* then went off, set topgallant sail, and stood after her; by this time the brig was about 400 yards ahead; in 15 minutes the vessels were square abreast, the *Princeton* shooting ahead fast; when the race was discontinued, and the *Princeton* hauled up to cruise. During the race, the *Princeton* used the centre boiler only, there being neither steam nor fires on the two wing boilers; the steam pressure was 6 pounds per square inch in the boilers, cut off at ⅓d stroke from commencement; throttle $\frac{1}{32}$d open; revolutions of the screw per minute, 17. Speed of the *Princeton* during the race, 8¾ knots per hour; during the last few minutes she was gaining on the brig at the rate of about 100 feet per minute. Draft of *Princeton* during race, 15 feet 4 inches forward, and 18 feet 8 inches aft; slip of the screw, 60·85 per centum; consuming at the rate of 400 pounds of anthracite per hour.

The screw as an auxiliary, proved exceedingly efficient when the *Princeton* acted as a blockading vessel off the port of Vera Cruz during the Mexican war. While thus employed, she would lay off and on some six miles distant from the city, under easy sail, with the fires banked in the furnaces of the centre boiler only, the steam stop valves being closed; with the wing boilers, about 6 lbs. of steam was kept on. When a vessel was descried, the fires in the centre boiler were spread, fresh coal

thrown on, and the fan blast started; in fifteen minutes the generation of steam would allow the use of the engines, and by the addition of a slight power from the screw to the sails, the speed would become sufficient to overhaul any vessel. In a calm or in a very light head wind, the steam from the centre boiler alone would supply the engines with 12 lbs. boiler pressure for 16½ revolutions of the screw; throttle, $\frac{1}{18}$th open; cut off, ⅓d stroke from commencement; back pressure in condenser, 3·2 lbs. pr sq. in; speed of vessel, 3¾ knots per hour; consumption of anthracite coal, 700 lbs. per hour, with the fan blast driven violently. During sixteen successive days the fires were thus kept banked on the centre boiler, spreading and using them occasionally when a chase hove in sight; there was consumed a total of 32,960 lbs. of anthracite, or 2060 pounds per 24 hours.

Under the above circumstances, in the month of June, 1846, off Vera Cruz, the temperatures of the wing boilers from radiation and leakage through the stop valves from the centre boiler, was 160° F., and 140° F.; temperature of coal bunkers immediately over boilers, 104° F.; temperature of engine room at 10 feet from front of boilers, 115° F.; temperature on deck averaged 90° F., of water, 80° F. The boilers were covered with one thickness of felt, on which was placed a sheet iron casing, over which came a wooden casing, covered in turn by a last one of sheet iron. The sides of the wing boilers formed the sides of the bunker, and the coal was thrown against them.

The Princeton without steam, as a sailing vessel only.—The screw of the *Princeton* was fitted with a simple clutch coupling, which by a lever could be thrown in or out; when out, the screw revolved by the pressure of the water against it, caused by the progress of the vessel, and opposed much less resistance to the speed of the vessel when under sail alone than if it had been dragged in a fixed position. The *Princeton* frequently sailed in this manner, and the following table gives the performance:

Performance of the U. S. Screw Steamship Princeton under sail alone, with the Screw uncoupled, and revolving in the water by the progress of the vessel, embracing all the sailing found recorded in the Logs at the Navy Department.

Number of hours.	Speed of the vessel pr hr. in knots of 6082¾ feet.	Wind.	
		Direction.	Kind.
158	3·966	Forward the beam.	Light breeze.
99	5·000	" "	Moderate "
42	5·454	" "	Fresh "
202	3·265	Abeam.	Light "
211	5·794	"	Moderate "
207	6·345	"	Fresh "
153	4·606	Aft the beam.	Light "
142	6·451	" "	Moderate "
24	7·417	" "	Fresh "
Mean speed under sail alone.	5·125		

The above table sufficiently explains itself, and it is only necessary to add that the maximum speeds under sail alone were as follows, viz: 212 geographical miles made in 24 hours during August 3d, 1845, or 8·833

knots per hour. Course of vessel, S. W., wind E. and moderate, with a smooth sea and all sail set.

During 12 hours of July 25, 1847, made 122 geographical miles, or 10½ knots per hour. Course of vessel, E. by S.; wind, a fresh breeze from southward and westward, with smooth sea and all sail set.

During the 24 hours of July 29, 1847, made 221 geographical miles, or 9·21 knots per hour. Course of vessel, direction and strength of wind, sail, sea, &c., same as on the 25th inst., immediately preceding.

When the vessel was under sail alone, the screw being uncoupled and revolving by the pressure of the water, its revolutions, compared to the speed of the vessel, were for a mean of several thousand observations, as follows, viz:

The Ericsson screw made 1·9700 revolutions per minute for each knot per hour of the vessel's speed. The Stevens screw made 2·2934 revolutions per minute for each knot per hour of the vessel's speed. Per unit of vessel's speed, therefore, the revolutions of the Ericsson and Stevens screws were in the ratio of 1·0000 to 1·1642. The pitches of these screws were in the ratio of 1·0789 to 1·0000, or nearly in the inverse ratio of their revolutions.

The screws would not revolve with a less speed of vessel than two knots per hour, but the ratio of their revolutions to the speed of the vessel was sensibly the same, whether that speed was 3 knots or 10 knots per hour.

Taking the average speed of the vessel under sail alone, at 5·125 knots per hour, the revolutions of the Ericsson screw would be 10·0963 per minute, making its speed 3·486 knots per hour, at which rate the speed of the vessel would exceed it by 1·639 knots per hour, or the speed of the vessel would be greater than that of the screw by 47·00 per centum of the latter.

Taking the speed of the vessel at the same, 5·125 knots per hour, the revolutions of the Stevens screw would be 11·7537 per minute, making its speed 3·761 knots per hour, at which rate the speed of the vessel would exceed it by 1·364 knots per hour, or the speed of the vessel would be greater than that of the screw by 36·27 per centum of the latter.

It must, however, be considered that by the passage of the vessel through the water there is generated a following current of considerable speed, and that the speed of the screw under the above circumstances must be compared, *not* with the speed of the vessel through the water, but with that speed *less* the speed of the following current. The speed of this following current it is impossible to determine; but with hulls of good model at medium speeds, it may be estimated at about one-fifth the speed of vessel. If, therefore, we make a deduction of one knot from the speed of vessel, (5·125 knots per hour,) it leaves a speed of 4·125 knots of vessel to be compared with a speed of Ericsson's screw of 3·486 knots per hour; and of Stevens' screw of 3·761 knots per hour; on which assumption the retardation of the vessel's speed would be equal to the effect of a power required to drag the Ericsson screw (not revolving) through the water at a rate of 0·639 knots per hour, and the Stevens screw at a rate of 0·364 knots per hour. The resistance of the screw thus dragged would not equal that of a disk of the same area, inas-

much as the screw surface is not placed at right angles, but obliquely to the direction of motion; and as the effect of power on speed is as the cube root of that power, it will be perceived that the *drag* of the screw, or the retardation of the vessel's speed by it, must be very little indeed, probably in the majority of cases not sensible to the log. In confirmation of this result, I find in *Bourne's Treatise on the Screw Propeller*, page 142, where the conclusions of the French experimenters on the screw vessel *Pelican* are cited, the following recommendations, viz: "but in the case of merchant vessels with auxiliary power, they recommend that the screw shall be made merely capable of revolving freely when disengaged from the engine, in the manner of a patent log. A screw thus fitted, will, they say, offer scarcely any obstruction to the progress of the vessel under sail, while it will possess advantages in strength and simplicity, such as would not be otherwise attained." In the last and most perfect screw vessels of the French Navy, as the *Napoleon* for instance, a screw of four blades is used, incapable of being hoisted out, as in the British Navy, where two bladed screws are wholly used; this number of blades being imperative where the screw is to be hoisted out. In the *Napoleon* the screw is simply uncoupled as in the *Princeton*, when it is desired to navigate the vessel with sails alone.

In addition to the mere *drag* of the screw just stated, there is a further retardation of the vessel's speed due to what is usually termed the screw's friction on the water; this is probably greater than the former. In the absence of all exact experiment, it is impossible to determine the value of these retardations, but I am persuaded it does not exceed one-tenth the vessel's speed; that is to say, a vessel which, disencumbered from the screw, would make 10 knots under sail, would make 9 knots dragging it.

In the following tables of the performance of the *Princeton*, there will frequently be found what is called *the negative slip of the screw. This, however, only occurs when the vessel is under sail and steam; it never occurs under steam alone.* When it has place it is indicated by the minus (—) sign prefixed. By negative slip of the screw is meant the excess of the vessel's speed over the forward speed of the screw (revolutions multiplied by pitch) in per centums of the latter. Under these circumstances it might be supposed the screw, so far from assisting, was retarding the vessel's speed. Such, however, is not the case, owing to the facts of the screw being located at the stern, and the generation of a following current of considerable velocity by the advance of the vessel; this current flowing in behind the stern, supplies chiefly the water on which the screw acts, and it may be slipping considerably in this water and yet apparently have less speed than the vessel.

Boilers.—The *Princeton* had two sets of iron boilers. The first set was designed by Ericsson; the second set by Chas. H. Haswell, at the time Engineer in Chief U. S. N. Both sets corroded out very rapidly. The first set underwent very extensive repairs in Dec. 1846, 2 years and 10 months after they were built, and they were taken out in April, 1847, 3 years and 7 months after they were built, so completely corroded out as to be impossible of repair. The last set on their return to the United States after two years' service were found to be greatly corroded.

The corrosion of the first set of boilers was greatest on the semi-circular

top of the shell above the water line, though the whole water surface was severely acted on. The top of the shell was not acted on in particular places, nor did the metal present honeycombed or pitted appearance, but the wasting seemed uniform over the whole extent. The reason was at the time a subject of general speculation, but none of the causes offered met the case. After the breaking up of the vessel, and the removal of the machinery, I had occasion to minutely examine the latter, and I found the brass feed pump of the port engine, its valves, valve seats, and valve chests, also of brass, in a completely corroded condition; the whole surface being honeycombed or pitted very thickly and very deeply, extending in many places nearly through the ⅝ths inch thick metal. On examining the corresponding feed pump of the starboard engine, made of the same material, similarly situated and performing the same office, I was surprised to find it in excellent order, with no marks of corrosion. At first I was at a loss to account for this difference, but upon reflection, recollected the *Princeton's* engines had no independent *bilge* pump, and that when under way the bilge water, which made very fast, (owing to a steady stream being admitted through the pipe surrounding the propeller shaft where it passed through the dead wood of the vessel, for the purpose of keeping cool and lubricating the stern bearing of the same shaft,) was taken out of the ship by a bilge injection, communicating with only the port engine, air pumps, and reservoir; the starboard engine having no bilge injection. Of course, the water fed to the boilers by the port engine pump, and the pump of each engine fed to all three boilers, was greatly mixed with bilge water, composed of sea water strongly impregnated with the acids and soluble matters of the green white oak of which the chief part of the vessel was made; and as these acids appeared to have had sufficient strength to attack and destroy the brass of the pump, it is highly probable they were also the cause of the far more rapid destruction of the iron of the boilers. In connexion with the foregoing I will also state, that no scale was made upon the fire surface of the boilers during the year I was attached to the vessel in the capacity of engineer, while steaming in the Gulf of Mexico, although the water in the boilers was never carried at less than twice the natural concentration, and frequently for days at two and a-half times the natural concentration, the steam pressure ranging from 10 to 12 lbs. per square inch. Although every part of the fire surface of the first boilers could be reached, and the scale jarred off had there been any there, yet there never was found enough to make the operation of *scaling* necessary. The U. S. steamship *Mississippi*, steaming at the same time in the same waters with copper boilers, made scale to a very inconvenient extent, with the water in the boilers carried at only one and three-quarters the natural concentration, with about the same pressure of steam. The *Mississippi* made scarcely any water, was built of seasoned live oak, and had independent bilge pumps. I ascribe the remarkable cleanness of the *Princeton's* boilers to the dissolving of the scale by the acid of the bilge water, and also to the continual falling off of the scale by the continual removal of impalpably thin layers of the iron by the action of these acids. In the engine room of the *Princeton*, the stench from the bilge water was overpowering.

Both sets of boilers were utterly inadequate to supply the engines with the steam of proper pressure they could work off, cutting off at ⅓d the stroke from the commencement. By proper pressure, I mean 20 pounds in the boilers per square inch with wide throttles. The most violent forcing with the fan blast could not effect a reasonable approach to this; nor could there be maintained, for 24 or 36 consecutive hours, by any practicable amount of forcing the fires with the blast, over 10 pounds of steam, with the throttle half open, and cutting off at ⅓d. Much smaller engines could have worked off all the steam the boilers could supply, and of course could have developed the same power.

In calculating the evaporation of the boilers, I have confined myself to the steaming done after Commodore Stockton resigned the command, both because the data was sufficiently large, and because for that time only were the steam logs complete in all the elements; also, because the selection of the fuel was made with greater care while the vessel was making experimental trials. In calculating evaporation, Regnault's data for the latent heats of steam is used. In order to burn from 1200 to 1400 pounds of coal in either set of boilers, the steam pistons of the blowing engines were required to make about 30 double strokes per minute. These engines were two in number, with cylinders of 12 inches diameter, and 14 inches stroke of piston, the exhaust communicating with the condensers of the large engines. Worked by each blowing engine was a centrifugal blower of 4 feet diameter, composed of six fans 22½ inches long by 12 inches deep; the blower was geared up with a belt, to make six revolutions for each double stroke of the steam pistons, the average being 180 revolutions per minute. With wide throttles, the pistons of the blowing engines would make 200 double strokes per minute. These engines were much larger than was required or could be used. The natural draft of both sets of boilers was very defective; the utmost of anthracite that could be burned with it was 6 pounds per hour per square foot of grate surface, or about 800 pounds per hour.

The economical evaporation of these boilers was only up to the ordinary standard. There was in both much too little heating surface for the fuel consumed, and the heated gases, especially with the first boilers, were delivered into the smoke chimney at a very high temperature. I have witnessed on a dark night, when using soft anthracite, and forcing the blowers strongly, a mass of dense red flame driven out from the top of the chimney, of its full diameter, and rapidly. On one occasion when forcing the vessel, this mass of red flame was of sufficient volume to stream over the taffrail, and brightly light up the decks around, alarming the officers of the ship, and requiring the cessation of the blowers.

The last boilers were superior in type to the first. They contain a considerably greater amount of heating surface in the same sized shells, and gave much higher economical results; but they were inaccessible for cleaning or repairs, while every part of the first boilers could be reached.

First Boilers.—Three iron boilers, with one tier of deep return flues. The boilers are placed side by side, with one smoke chimney in common.

Length of each boiler, . .	26 feet.
Breadth " . . .	7 "
Height " . . .	9 " 4 inches.

Area of the total heating surface in the three boilers, .	2420 square feet.
" " grate " " .	134 "
Aggregate cross area of the direct flues " .	27,120 "
" " return " " .	15,708 "
Cross area of the smoke chimney, . .	13,635 "
Height of the smoke chimney above the grates, .	32 feet.
Capacity of steam room in the three boilers, .	1222 cubic feet.
" " " steam pipes, &c.,	1297 "
Weight of sea water in the three boilers, (12 inches above top of flues, weighed,)	76,160 pounds.
" of the three boilers, &c., complete, .	128,128 "

PROPORTIONS.—Proportion of heating to grate surface, .	18·060 to 1·000.
Proportion of grate surface to aggregate cross area of the direct flues,	4·941 "
" " " " return "	8·531 "
" " to cross area of smoke chimney,	9·828 "
Square feet of heating surface per cubic foot of space displacement of piston per stroke,	22·368
" grate " " "	1·239
Cubic ft. of steam room per cubic ft. of steam used per stroke of piston,	24·050

LAST BOILERS.—Three iron boilers, with double return, drop, circular flues. The boilers are placed side by side, with one smoke chimney in common.

Length of each boiler, . .	26 feet.
Breadth " . . .	7 "
Height " . . .	9 " 4 inches.
Area of the total heating surface in the three boilers, .	3000 square feet.
" " grate " " .	136 "
Aggregate cross area of the upper row of flues in the three boilers,	18·363 "
" " middle row " "	16·762 "
" " lower row " "	16·762 "
Cross area of the smoke chimney, . .	13·635 "
Height of the smoke chimney above the grates, .	40 feet.
Capacity of steam room in the three boilers, .	949 cubic feet.
" " " steam pipes, &c.,	1024 "
Weight of sea water in the three boilers, (calculated,)	88,860 pounds.

PROPORTIONS.—Proportion of heating to grate surface,	22·059 to 1·000.
Proportion of grate surface to aggregate surface of upper row of flues,	7·046 "
" " " cross area of middle " "	8·114 "
" " " " lower " "	8·114 "
" " " " smoke chimney,	9·974 "
Square feet of heating surface per cubic foot of space displacement of piston per stroke,	27·729
" grate " " "	1·257
Cubic ft. of steam room per cubic ft. of steam used per stroke of piston,	18·990

(To be Continued.)

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*Stenson and Co.'s Patent Welding Hammer.**

Compact soundness and homogeneity in wrought iron, are desiderata which practical men connected with engineering and smith work in general, have long sought after. But iron being subjected, during forging, to every variety of torsion, punching, and other tests, in the multiform uses to which it is made subservient, any defect occurring by cleavage or splitting while in the hands of the workman, is a direct loss both in time and material. Every improvement, therefore, in the welding, and greater uniformity in the character of the iron, cannot fail of being highly appreciated.

* From the London Mechanic's Magazine, March, 1853.

When bars made from "piled" iron, imperfectly welded, are used as piston or other rods, working through stuffing-boxes, longitudinal seams or lines of cleavage are frequently apparant throughout their length. The edges of these dark lines are usually rough and serrated, and are the too frequent causes of premature destruction to the hempen packings through which they work.

Defects in the welding of piled iron are also frequently manifest in the cleavage and lamination of the tyres on carriage wheels. It is no uncommon thing to see the tyre of a coach-wheel, after having only been a short time at work, and when but one-fourth or one-sixth worn, split and divide like the leaves of a book—a defect which at once renders its replacement indispensable. A compact iron was formerly produced in the "Catalan forge," or "Bloomery fire;" the fuel used being charcoal, which was supplied from the extensive woods then abounding in many parts of England.

By means of this private process, iron was made directly from the ore, and brought out of the fire in a solid mass, which, by being repeatedly heated and hammered, was ultimately reduced to the size and form required. But as those ancient woods became exhausted, the iron manufacture gradually retired from its former localities, and took its position chiefly in those districts where the coal-fields offered a cheap and abundant supply of fuel. The iron made by coke, however, though produced at a cost greatly below that of the charcoal forges, was found to be of a quality so inferior to that of the latter as to render improvement not only desirable, but indispensable to a successful competition and an abundant production.

The conversion of pig into malleable iron, by the process of "puddling," as invented by Cort, was an important step towards the desired end; but the iron thus made was found to be of a weak nature, known by the term "cold-short," more especially when the pig had been produced from ores containing an excess of silicon, phosphorus, sulphuret of iron, or other foreign matters.

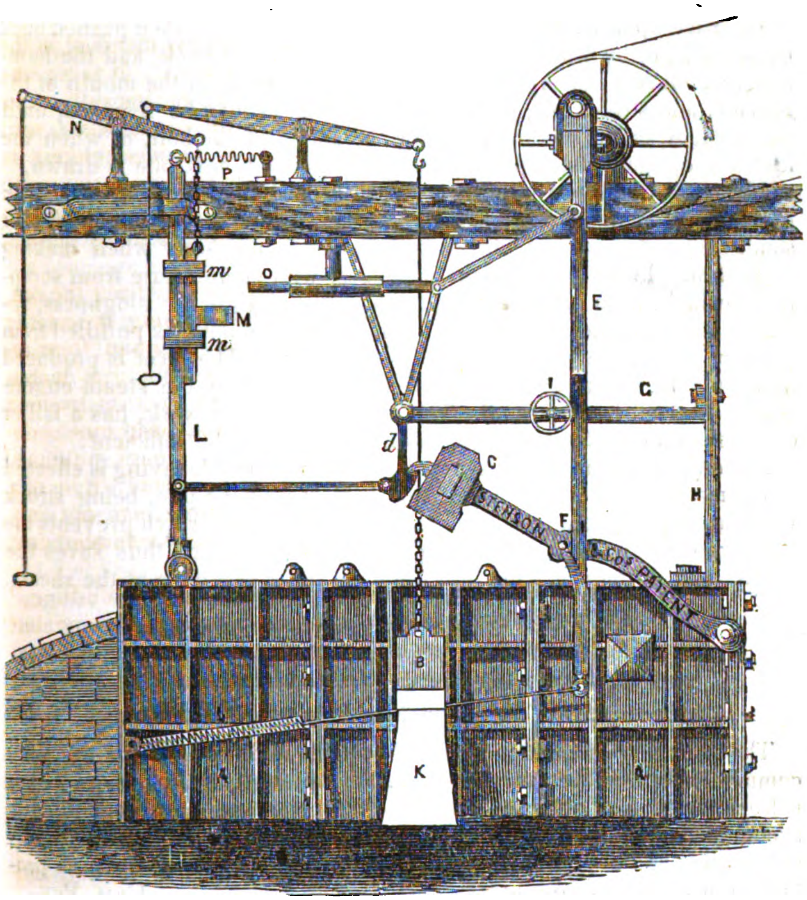
With a view to the production of a more fibrous character in the iron, came next the "doubling and welding," or "rolling" the puddled balls, after they had been hammered, into "rough bars" or "puddled bars"—a method now so generally adopted in our iron works. These puddled bars, being cut to the required lengths, are placed one upon another, and formed into "piles," which may be composed of from two or three to eight or ten plates. The furnace is now charged with as many of these piles as may be convenient, and when they are at a high welding heat the drawing and rolling of the charge commences.

The object effected by means of the patent process is a more perfect welding of the pile into a solid mass than has hitherto been accomplished; this preventing cleavage or lamination either in forging or in wear.

The usual method is to take the pile out of the furnace and draw it to a considerable distance along the floor to the rolls. During this time, the air acting upon and between the plates composing the pile, produces an oxidation and a cooling of the iron, which renders the welding imperfect. But by the patent process the welding is effected at the instant the pile

leaves the furnace, after which it is passed through the rolls in the usual manner.

The engraving represents Stenson and Co.'s Patent Welding Hammer, as used at the Patent Iron Scrap Forge-Works, Northampton.



A A is the reverberatory furnace, in which the iron is heated previous to being rolled into finished bars. B the furnace-door, which is lifted by a lever. C the patent hammer, resting upon a catch, *d*. E a lifting-rod, which is in constant motion, and provided with a catch for lifting the hammer by means of the stud at F. G a stay which carries the friction roller, I; this roller is the fulcrum on which the edge of the lifting-rod, E, vibrates. The lifting rod is pressed up to the roller by means of the spring, J. H, a vertical stay from the top of the furnace to a beam overhead, which carries the driving-pulley, levers, &c. K, a cast-iron block, about 12 inches square and 2 feet high, supporting an anvil, the face of which

is level with the heating-floor of the furnace. L, a vertical lever, the lower end working in a joint, and the upper end made to vibrate when pushed back by the sliding bolt, O, and brought back to its place by the spring. M, a slide working between two guards, *m m*, and lifted by means of the lever, N. When the door, B, is raised, and a pile of fire brought out of the furnace upon an anvil, the slide, M, is lifted, and is then pushed back by the bolt, O, by which the catch, *d*, is also thrown back, and the hammer immediately falls upon the pile as it is drawn from the mouth of the furnace, and strikes one, two, or more blows, as may be required, until the slide, M, is allowed to fall below the action of the bolt, O, when the hammer, C, again rests upon the catch, *d*, until the next pile is drawn.

Hammers of various weights are used, according to the size of the iron in course of manufacture; a head of 50 pounds being found sufficient for small piles, while one of 200 or 300 pounds is necessary when making large iron. In the works of the patentees, who manufacture from scrap-iron—which, from its more fibrous character and greater toughness, requires more hammering than that of the ordinary quality as puddled from pig-iron—this large weight is always employed. The effect is produced by simple means, and the machinery is propelled by the steam engine which drives the rolling mill. The hammer, when at work, has a fall or compass of about 2 feet 6 inches, which is found to be sufficient.

Not only is a sound weld secured, but a considerable saving is effected in the manufacture by the use of this hammer; as the pile, being struck while at its greatest heat, is rendered into a solid mass, which prevents the over-drawing during the process of rolling into bars, and thus saves the greater part of the waste usual in cropping the rough ends at the shears.

For the Journal of the Franklin Institute.

Description of the Steam Fire Engine at Cincinnati.

The following description of the Cincinnati steam fire engine has been communicated for the *Journal* by T. W. Bakewell, Esq., who obtained it from Mr. A. B. Latta, the builder. We believe no previous authentic account has been published of this machine, which has excited considerable notice, and is probably destined to play an important part in the protection of buildings from fire. COM. PUB.

This machine has been in operation since the 1st of January, 1853, and has proven itself successful beyond all doubt, although the project has been tried before, and set down as impracticable, because it requires a machine that can be brought into operation as soon as hand apparatus. This, with other objections, such as running over rough streets, laying on uneven ground when at work, running up and down hill, and a host of other objections, have been causes for abandoning the use of steam heretofore; but these objections have been completely set aside by the operation of this machine. The first thing of importance in this engine is the principle of generating steam, which is a very old principle, but has not been properly understood heretofore. It is the same that is now being projected by a Frenchman, which he calls a serpentine boiler, which is a con-

tinuous pipe coiled spirally or otherwise, so as to let the fire have a chance to surround it; the water being injected, it is instantly converted into steam; this accounts for the short time it requires to raise steam. This machine resembles a locomotive in some respects; it has cylinders on both sides, placed like those of a locomotive, the pumps being directly forward of the steam cylinders; the piston rods run directly out of the steam cylinders, and enter the pumps; the engines are so arranged as to couple to the driver at pleasure; this is done in order to drive the machine by steam when desired, and to hold back when going down hill, or assist in going up; this is an important consideration; the drivers resemble those of a six wheel locomotive, being aft of the fire box; the forward end of this machine runs on one wheel and revolves round like that of the velocipede, by which means the machine can be turned any where in the length of itself. Another reason why it should only have three wheels is, that its bearings are like those of a three-legged stool; it always comes to a bearing, without straining or twisting the machine; the perfect adaptedness of this combination to suit the circumstances, is the cause of its success. This machine is constructed of iron and brass, except the wheels, which are partly of wood. I believe the worst throwing it has ever made was when it was brought out to throw before the Hope Hose Co. of Philadelphia; I believe it only threw 160 feet; the greatest throw it has ever made is 240 ft. from the end of the nozzle to where the solid body of water fell, through a 1¾ inch nozzle; and 291 ft. to where the spray fell. This machine will discharge about 2000 barrels of water in one hour. It throws from one to six streams of water, and has two suctions 6½ inches in diameter, and 24 feet long; each one is in one piece; these are always attached to the engine; they cross each other in front, and lay back on either side; this is a very important improvement, and a saving of time and labor in attaching the suctions. The time required to put this machine in operation is five minutes; it requires four men and four horses to operate it, and will do as much as six of the largest class hand apparatus. This will give the reader an opportunity of estimating the economy in the use of steam for this purpose. Any further information can be obtained concerning it, by addressing A. B. Latta, who is the projector and builder of this machine, at Cincinnati.

Now, by way of illustration, we may notice its performance at one fire, to show the effect produced by this machine, compared with that by the hand apparatus. A fire occurred on the 20th of May, 1853, on Twelfth and Main streets, at 3 o'clock P. M.; the alarm was given, the steam engine ran eight squares, laid her hose, which was one square from the fire, and put the first water on the fire, which was all done in about five minutes; the hand apparatus, notwithstanding there were some of them stationed only two squares from the fire, were not at work until the steam engine was under way. In eight and a half hours' work (making due allowance for waste of water,) she poured into the fire about 15,000 barrels of water; it was a large brewery with sale cellar; the wind was high, and nothing but a cataract of water could have saved the entire square from destruction. This will show what can be done with steam in putting out fires. Arrangements are now making for four more of these machines by the Chief Engineer of the fire department. This will give the fire department of Cincinnati the greatest strength of any in the Union.

A Full-Grown Gasometer.

Some few years since several of the most "eminent engineers" of the day gave evidence before a Parliamentary committee to the effect, that a gasometer of greater diameter than 35 feet would be very dangerous; and recommended that in all cases where this limit was approached, a series of strong walls should be built round the gasholder, in order to lessen the injury which the almost inevitable "explosion" might entail. Although practical men subsequently proved such an idea to be chimerical, no one, that we recollect of, has attempted to make a gasometer at all approaching in size to one described in the *Wolverhampton Chronicle* as having been lately manufactured at Smethwick. Its diameter is 165 feet. By bringing a recent patent to bear upon its construction, the makers have affected a saving of 2000*l.* in raw material, through the absence of the heavy iron frame work which usually supports the roof (if we may so call it) of a gasometer. The top is quite flat, experience having proved that with a certain mode of construction all internal support is superfluous. This gigantic gasometer is intended for the Sheffield Consumers' Gas Company. The manufacturers, Messrs. Horton, are also engaged in manufacturing telescopic gas-holders on a new principle (the subject of another new patent), by which still further economy, it is said, in labor and material is insured.—*London Builder*, *No.* 532.

Remarks.—The eminent engineers spoken of above must be relatives of the one who swore before a Coronor's Jury, that he recollected distinctly that the explosion of the "big gun," killed Mr. Jefferson. The gas holder of the Philadelphia Gas Works erected in 1850 is 140 feet in diameter and 74 feet high, built on the telescopic principle of course. (*See Journal of the Franklin Institute* 3d. *Ser.*, *Vol.* xxi, *p.* 292). The gas holder now in process of construction at the new works is 160 feet in diameter, and 90 feet high, with a top nearly flat, having only rise enough to carry off the water, and without the usual framing and rafters for sustaining the crown. From the brief description of the Sheffield holder, we should think the two almost identical in construction.

Ed.

For the Journal of the Franklin Institute.

Steam Boiler Explosion at Covington, Ohio.

Our correspondent at Cincinnati, Ohio, under date of May 31st, 1853, says: "The boiler explosion at a Rolling Mill near Covington, presents no feature of special interest. The boiler was cylindrical, 34 inches diameter, (no flue,) wrought boiler plate end, turned at a sharp angle round the edge to form a flanch. The boiler had been leaky at this edge for some time previous, and at the time of explosion was parted from the boiler at the angle all round, converting the boiler into a rocket-like projectile, which flew about 400 feet, and fell into the river. The end shows the character of the rupture."

For the Journal of the Franklin Institute.

United States Auxiliary Screw Steamship Massachusetts. By B. F. Isherwood, Chief Engineer, United States Navy.

The *Massachusetts* was originally built for a steam packet to ply between New York and Liverpool, but not proving a satisfactory speculation, she was next sent to the East Indies, and on her return, the Mexican war being in progress, was sold to the army for a transport. After the treaty of peace she was transferred to the Navy Department, and sent to the Pacific on the California cost, whence she has just returned to Norfolk, Virginia. The abstract of her logs, hereinafter given, comprises the whole of her performance while belonging to the Navy.

The *Massachusetts* was originally designed for purely an auxiliary steam power, to be used only in calms, and when the wind was so light as to give the vessel with sails alone a less speed than 5 knots per hour. With this design, it was necessary to arrange the screw so that it could be hoisted out of the water when the vessel was not under steam. This was accomplished in the manner hereinafter described.

The machinery of the *Massachusetts* was designed by Captain John Ericsson, and cost $24,000. The entire original cost of the vessel, including machinery, was $80,000.

When transferred to the Navy, the *Massachusetts* was fitted with Ericsson's surface condenser, in addition to an ordinary jet condenser kept ready for use when the other was out of order. This surface condenser answered very well for a time, producing a tolerable vacuum and furnishing the boiler with a sufficient supply of fresh water, the loss by leakage &c., which was trifling, being easily supplied by an evaporator. This condenser was essentially the same as Hall's, from which it only differed by the position of the condensing tubes, which were vertical in Hall's, and slightly inclined from the horizontal in Ericsson's. It was found that the very thin tubes composing the condensing surface in the *Massachusetts*, were, though of copper, rapidly corroded out by the sea water, honeycombing over the whole surface; the surface condenser was therefore removed from the vessel, and the steaming recorded in the logs was done with the ordinary jet condenser.

The following are the dimensions of the vessel, machinery, &c.

Hull.—

Length on keel,	155 feet.		
Length on deck,	160	"	
Length from forward part of billet-head to after part of taffrail,	178	"	
Breadth of beam for tonnage,	31	"	8 inches.
Extreme breadth of beam on deck,	32	"	2 "
Depth of hold,	20	"	
Depth of keel and false keel,	23	"	
Deep load draft, { Forward,	15	"	
Deep load draft, { Aft,	16	"	
Mean draft for the time of steaming comprised in the logs,	15	"	
Area of immersed amidship section at 15 feet draft,	358·4 sq. feet.		

Rig.—The *Massachusetts* is ship rigged, and spreads 21,082 square feet of canvass in the principal sails. Her rig is what is known as

Forbes', its peculiarity consisting chiefly in dividing what would be the ordinary topsail by an additional yard into two sails, making as it were double topsails with aggregate surface equal to that of the usual single topsail. This arrangement is obviously for greater ease in handling the sail. From stem to centre of foremast is 31 feet; thence to centre of mainmast 57 feet; thence to centre of mizzen mast 42 feet.

The space occupied by the machinery, coal, &c., extends from the stern post 47 feet; and the bunkers hold 80 tons of coal.

Hoisting out Apparatus of the Screw.—Plate I.—The arrangement by which the screw is hoisted out of the water, consists of a shaft, on which is a capstan or hand wheel of eight arms, measuring 24 in. from the centre of the shaft to the extremity of the arm. This shaft carries an endless screw of $4\frac{1}{8}$ inches on the pitch circle, which works into a wheel of $32\frac{1}{2}$ inches diameter, $2\frac{1}{2}$ inches face, and $1\frac{5}{8}$ inch pitch of teeth. The shaft of this wheel carries a pinion of $8\frac{3}{4}$ inches diameter working into a wheel of $42\frac{1}{4}$ inches diameter, 6 inches face, and $2\frac{3}{16}$ inches pitch of teeth; the shaft of which in its turn carries a pinion of $9\frac{1}{2}$ inches diameter, working into a wheel of $55\frac{3}{4}$ inches diameter, 7 inches face, and 3 inches pitch of teeth. The diameters of all the above pinions and wheels are to their pitch circles. On the shaft of the last wheel, the upper end of the wrought iron lifting arm is keyed, the lower end encircling the projecting portion of the hub. The weight of the lifting arm is 1200 pounds. The screw is not keyed to its shaft, which latter is square in section (with the angles a little taken off to prevent turning,) and merely ships into the hub. The outboard or screw shaft is drawn by levers directly inboard into the hollow part of the next section of shaft, sufficiently far to allow it to clear the hub of the screw; the hand wheel or capstan being then turned by two men, the lifting arm revolves, carrying the screw with it, and by half a revolution lifts the screw out of water, and elevates it perpendicularly 14 feet, where it is secured by locking the gearing and by hooking braces to it from the vessel. When it is required to lower the screw, the reverse operation is performed. It required from 20 to 30 minutes to raise or lower the screw and to secure it ready for sailing or steaming.

By the above arrangement it will be perceived, that in *backing*, the thrust of the screw is communicated by the collar on the hub to the lifting arm; this arm must therefore be made sufficiently strong to hold the thrust against its leverage of 7 feet. In *going ahead*, the thrust of the screw is communicated by the hub to the after end of the shaft; the after extremities of the shaft and of the bore of the hub being tapered to the form of a frustrum of a pyramid.

Screw.—One true screw of bronze. The hub is cast in one piece, and the arms are cast separate and riveted to the hub. The band or drum is cast in six pieces, and riveted by flanches to the arms. It will be observed that these parts of the blades pierced by the rivets are made thicker by raised ribs, in order that the strength of the blades may not be weakened by the riveting. The peculiar form of hub resulted naturally from disposing a minimum quantity of metal most effectually to resist the cross-strain of the blades.

The weight of the screw is 5145 pounds: it makes one revolution to each double stroke of engine piston.

Diameter of screw,		9 feet 6 inches
Diameter of drum (outside),		5 " 2 "
Diameter of hub (circular part),		1 foot 7½ "
Pitch of screw,		20 feet.
Mean fraction of pitch used,		0·638
Length of screw, from hub to drum, in direction of axis,		1 foot 6 "
Length of screw, from drum to periphery in direction of axis,		2 feet 4 "
Helicoidal area of the six arms,	17·111 sq. feet,	
Helicoidal area of the six blades,	47·281 " "	
Total helicoidal area of the screw,		64·392 sq. feet.
Projected area of the six arms on a plane at right angles to axis,	8·808 " "	
Projected area of the six blades on a plane at right angles to axis,	34·465 " "	
Total projected area of the screw on a plane at right angles to axis,		43·273 " "
Radius of the centre of pressure of the screw in function of surface and square of the circumferential velocity of the surface,		3·346 feet.
Distance the centre of screw is below the surface of the water (at 15 feet draft),		6 feet 1 inch.

Engines.—Two direct acting, inclined, condensing engines.

Diameter of cylinders,	25 inches.
Stroke of pistons,	3 feet.
Space displacement of both pistons per stroke,	20·454 cubic feet.
The engines have a steam slide valve, and an independent slide cut-off, cutting off the steam at half stroke.	
Steam space between cut-off and slide valves, at one end of both cylinders,	0·611 " "
Steam space between slide valves and pistons, at one end of both cylinders,	0·581 " "

Boilers.—Two iron boilers, with circular flues behind the furnaces and horizontal iron tubes returned above the furnaces. Each boiler contains 79 iron tubes 2½ inches outside diameter and 9 feet 10 inches long. The boilers are placed side by side, with one smoke chimney in common.

Length of each boiler,	14 feet.
Breadth "	7 "
Height "	9 " 6 inches.
Area of the total heating surface in the two boilers,	1627 square feet.
" " grate " "	48 1-6 "
Aggregate cross area of the lower flues in the two boilers,	6·812 "
Aggregate cross area of the tubes in the two boilers,	4·828 "
Cross area of the smoke chimney,	5·242 "
Height of the smoke chimney above the grates,	42 feet.
Capacity of steam room in the two boilers,	280 cubic feet.
Weight of sea water contained in the two boilers,	25·700 pounds.

Proportions.—Proportion of heating to grate surface,	33·778 to 1·000.
Proportion of grate surface to aggregate cross area of lower flues,	7·071 "
Proportion of grate surface to aggregate cross area of tubes,	9·976 "
" " to cross area of smoke chimney,	9·189 "
Cubic feet of steam room per cubic foot of steam used per stroke of piston,	25·31

The natural draft of these boilers was very poor, as might be predi-

cated on their small calorimeter, about $\frac{1}{10}$th the grate surface, moderate height of smoke chimney, and large proportion of heating to grate surface, with the principal part of the heating surface in small tubes of very thin metal, and therefore very efficient in transmitting the heat. To compensate this deficiency of draft, and increase the power of the boilers, a fan blast was put into the smoke chimney to urge the fires to any required degree. During the whole steaming recorded in the logs, this fan blast was constantly and strongly driven, the steam following as soon as it was stopped, and during the latter part of the steaming, when the boiler had become considerably incrusted with scale and foul, even the most violent driving of the fan would not keep up steam during the operations of *blowing off* and cleaning the fires, the engines frequently stopping for want of steam on those occasions.

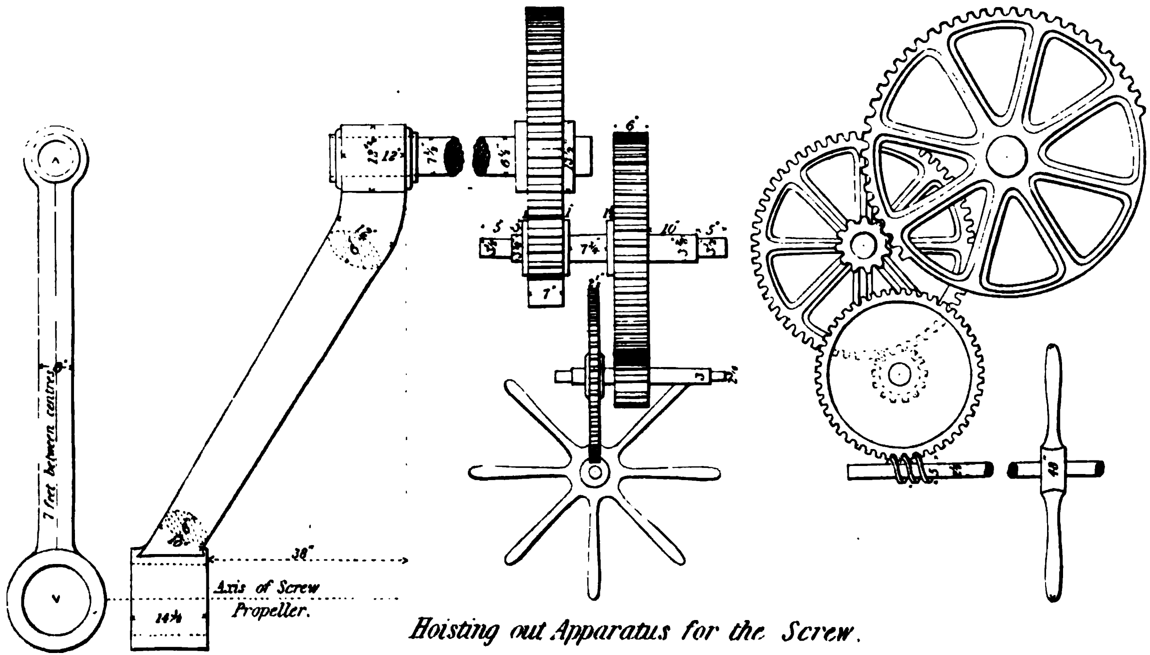
The evaporation by the boilers is calculated for a cylinder pressure 3 pounds less than the boiler pressure, and includes the loss of *blowing off* to maintain the sea water in the boilers at twice the natural concentration, and the loss betweeen the cut-off and steam slide valves and between the latter and pistons, but does not include the evaporation that furnished the small engine for the fan blast with steam. The total heat of steam is taken from Regnault's data.

The boilers were continually giving out by the corrosion of the tubes, which were so honeycombed over the whole of their thin surface and reduced in thickness, that the scale could not be knocked off without destroying them.

Remarks on the Logs.—The condition of the water is not stated in the logs, but as the wind was principally a light or moderate breeze, it is probable there was but a slight swell on or a moderate sea. The number of "consecutive hours" was taken for such lengths of time as the direction of the wind, steam pressure, double strokes of engine, pistons, &c., remained nearly constant, the extremes differing but a few per centums. The speed of the vessel was taken by the *chip log*, and as the top of the screw was but 16 inches below the surface of the water, its very great slip must have driven a considerable current aft, which affecting the log would cause its indications to be much too high; the true speed of the vessel must have been considerably less than what was logged. It must further be borne in mind that the force of the wind or kind of wind as recorded in the log, was judged of by the sensations of the observer on the deck of the vessel, and that what is logged as a gentle breeze ahead when under steam alone, is as really a calm, while what is recorded as a light breeze aft was in fact a moderate wind aft, and so on throughout. Inaccuracy in these particulars was unavoidable, but the log of the *Massachusetts* is in these respects as correct as the logs of other vessels, and the comparison is therefore not much affected. The amount of fuel consumed, though obviously inaccurately given in many cases, is what was actually put, or thought to have been put, in the furnaces during the hours recorded, and as the steaming was always commenced before and continued after those "consecutive hours," there are no corrections to be made for the heat expended in "getting up steam," or for burning down the fires before stopping.

With a view to compare the performances of the vessel under different

U.S.S. MASSACHUSETTS.



Hoisting out Apparatus for the Screw.

conditions at a glance, the following summary of the logs have been prepared; the mean draft of water did not vary materially, nor did the force of the wind or state of the sea.

Summary of the Results from the Steam Log.

	Under steam alone. Light breeze ahead.	Under Steam Assisted by Sail. Light breeze forward the beam	Light breeze abeam.	Light breeze abaft the beam.	Mean of the performance under steam assisted by sail.
Observed.					
Total number of hours,	419	259	189	112	560
Speed of the vessel per hour in knots of 6082⅔ ft.,	4·320	4·511	5·516	6·157	5·179
Steam pressure in boilers in pounds per square inch above atmosphere,	25	24	24	25	24
Part of stroke of piston, steam cut off at from commencement,	½	½	½	½	½
Proportion of throttle open,	Wide.	Wide.	Wide.	Wide.	Wide.
Double strokes of pistons made per minute,	37·55	35·94	38·76	40·84	37·87
Back pressure in condenser, in lbs. per sq. in.,	2	2	2	2	·2
Pounds of Penna. anthracite burned per hour,	621	679	680	701	684
Consumption of anthracite in tons of 2240 lbs. per 24 hours,	6·654	7·275	7·286	7·511	7.329
Centre of the screw below the surface of the water in inches,	73	73	73	73	73
Calculated.					
Steam pressure in cylinders before cutting off, in pounds per square inch above atmosphere,	22	21	21	22	21
Mean effective pressure on pistons throughout stroke in pounds per square inch,	27·93	27·06	27·06	27·93	27·06
Horses power developed by the engines,	199·27	173·60	187·22	216·73	182.92
Slip of the screw in per centums of its speed,	41·68	36·38	27·86	23·58	30·68
Pounds of anthracite burned per hour per square foot of grate surface,	12·893	14·097	14·117	14·554	14·201
Pounds of anthracite burned per hour per square foot of heating surface,	0·382	0·417	0·418	0·431	0·420
Cubic feet of steam of atmospheric pressure furnished per minute, from sea water of twice the natural concentration, with temperature of feed water 100° F., including loss by blowing off to maintain twice the natural concentration, and loss of steam in the cylinders, nozzles, clearance, &c., but exclusive of the steam used in driving the fan blast,	2227·34	—	—	—	2187·39
Pounds of steam evaporated per hour from one square foot of heating surface, under the above conditions,	3·020	—	—	—	2·966
Pounds of steam evaporated per hour by one pound of coal, under the above conditions,	7·912	—	—	—	7·054

An inspection of the foregoing summary shows the speed against a light breeze under steam alone to have been 4·320 knots per hour with a power of 199·27 horses; and under steam assisted by sail with a light breeze forward the beam 4.511 knots per hour with a power of 173·60

horses; with a power exerted of 199·27 horses, comparing the speeds as the cubes of the powers, this speed of 4·511 knots would become 4·723 knots; hence it appears that the application of sails with a gentle breeze forward the beam gave the vessel an increased speed of (4.723—4·320=) 0·403 knots, or 9.33 per centum more than before.

Now the slips of a propelling instrument measures inversely the relative resistance offered to it by the water it acts on and by the vessel propelled. In the first of the above cases, the slip of the screw was 41·68 per centum, leaving the resistance of the vessel to be expressed by (100·00 —41·68=) 58·32 per centum. In the last of the above cases, the slip of the screw was 36·38 per centum, leaving the resistance of the vessel to be expressed by (100·00—36·38=) 63·62 per cent.; and 63·62—58·32= 5·3 per centum, which expresses the decreased resistance of the hull to the screw resulting from the application of sails, and 5·3 is 9·09 per centum of 58·32, or nearly corresponding to the 9·33 per centum of increased speed as given in the preceding paragraph.

With a light breeze abeam and sail set, the engines exerting a power of 187·22 horses, the vessel made 5·516 knots per hour; with 199·27 horses power, this speed would become 5·631 knots; hence it appears that the application of sails with a gentle breeze abeam increased the speed (5·631—4·320=) 1·311 knots per hour, or 30·60 per centum more than before. Under steam alone the slip of the screw was 41·68 per cent., leaving the resistance of the vessel to be expressed by (100·00—41·68=) 58·32 per centum. Under sail, with a gentle breeze abeam, the slip of the screw was 27·86 per centum, leaving the resistance of the vessel to be expressed by (100·00—27·86=) 72·14 per centum, and 72·14—58·32 =13·82 per centum, which expresses the decreased resistance of the hull on the screw by the application of sails, and 13·82 is 23·7 per cent. of 58·32; to have agreed precisely with the preceding determination, it should have been 30·6 per centum.

With a light breeze abaft the beam and sail set, the vessel made 6·157 knots per hour, the engines exerting a power of 216·73 horses. With a power of 199·27 horses, this speed would become 5·987 knots per hour. The speed without sails with a power of 199·27 horses being 4·320 knots per hour, there results an increase of (5·987—4·320=) 1·667 knots per hour, or 38·6 per centum more than before due to the sails. Under steam alone the slip of the screw, as before stated, was 41·68 per cent., leaving the resistance of the vessel to be expressed by (100·00—41·68=) 58.32 per centum. With sail set and a gentle breeze abaft the beam, the slip was 23·58 per centum, leaving the resistance of the vessel to be expressed by (100·00—23·58=) 76·42 per centum, and 76·42—58·32=18·10 per centum, the reduced resistance of the hull due to sails; and 18·10 is 31·0 per cent. of 58·32; to have agreed precisely with the previous determination, it should have been 38·6 per centum.

The discrepancies in the last two paragraphs between the determinations of the decreased resistances of the hull, from the different speeds of the vessel with equal power, and from the reduced slips of the screw, are owing to the incorrect assumption that the slips at the calculated speeds would be the same per centum as at the observed speeds, and that the resistance of the vessel is as the cubes of the speed. Instead of this, how-

ever, being the case, the slip would be greater when the calculated speed is greater than the observed speed, and less when the calculated speed is less than the observed speed; for the greater the power exerted upon the vessel by the engines, the less obviously will be the power exerted on it by the sails, and *vice versa;* also, the resistance of a vessel like the *Massachusetts* must increase in a higher ratio than the cubes of the speeds. Thus, in the first instance, where the comparison is made between the vessel under steam alone, and the same under sail in a gentle breeze forward the beam, the speeds 4·320 and 4·723 knots per hour, being so nearly alike as not to affect the calculations, whose results agree almost exactly, being 9·33 and 9·09 per cent. In the second instance, the difference between the speeds 4·320 and 5·631 knots per hour is considerable, and the determination of the decreased resistance of the hull by the powers and speeds is 30·6 per centum, and by the slips of the screw 23·7 per centum, a difference of 6·9 per centum, showing the resistance of the hull to increase in a higher ratio than the cubes of the speeds. The same result is found in the third case, where the steam is assisted by sail and gentle breeze abaft the beam; the difference between the speeds 4·320 and 5·987 knots per hour, is a slightly greater difference than in the second case, and there is also a slightly greater difference (7·6 per cent.) in the results of the calculations for the decreased resistance of the hull, made first by the powers and speeds, then by the slips of the screw, which results are 38·6 and 31·0 per cent.

We may therefore theoretically take the slips of the screw as inversely a measure of the resistance of the hull in the different conditions of wind, water, sail, &c., but practically there are modifications to this truth, owing to the fact that the action of the same screw in water changes with different slips, and that as the slip is increased the efficiency of the screw surface for propulsion is decreased, because the water set in motion by the anterior part of the screw blade, presents less resistance to the posterior part of the same blade, in proportion to the speed that has been given it, and this speed is in proportion to the slip.

The evaporation given by the boilers is a very high one, but there is a considerable discrepancy in the two cases, for which it is calculated; a portion of this, however, may be accounted for by the greater rapidity of combustion in the case giving the less evaporation, and by the greater waste attendant on the hard forcing of the fires to obtain this increased combustion; but the greater part is doubtless due to errors in the measurement.

To be Continued.

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*Blowing up of a Chimney at Warrington.**

The enormous chimney of the Chemical Works of the Messrs. Muspratt, at Warrington junction, was on Monday last blown up by gunpowder. Passengers by the London and North-Western Railway, who have had occasion to pass the junction, about twenty miles from Liverpool, have frequently been surprised at its enormous altitude and dimensions. It was 406 feet high; 46 feet diameter at the base; 17 feet diameter

* From the London Mechanics' Magazine, January, 1853.

at the summit; contained 3,500,000 bricks, 3500 tons in weight; and cost 7000*l.* erecting. There was only one chimney higher in the United Kingdom. The one connected with the chemical works of Mr. Tenent, near Glasgow, was 20 feet higher; but it was a much less noble-looking shaft, inasmuch as it was narrower at the base, and contained about two-thirds less bricks. The works have not been in operation for about eight months, owing to arrangements being made to remove them to another locality. There being, therefore, no further use for the chimney, it was blown up under the superintendance of Mr. Stephen Court, engineer and architect of the St. Helen's Canal and Railway Company. A number of holes were delved round the base; and fourteen charges of gunpowder were inserted. At half-past 2 o'clock the train was fired. Nine charges exploded without any apparent damage being done to the stablity of the shaft; but the report of the tenth had no sooner been heard than the chimney was rent from top to bottom, and the huge fabric fell, crumbling away gradually from base upwards. The whole of the column fell nearly within the circumference of its own base. A dense cloud of lime-dust hid the ruins for a few seconds; but when it cleared away, the 3,500,000 bricks were perceived in the shape of a huge mound. A large crowd of spectators had assembled to witness the downfall. No accident of any kind occurred.

For the Journal of the Franklin Institute.

The Caloric Ship Ericsson.

We are informed on good authority, that this vessel has had removed from her the large cylinders of 14 feet diameter, 6 feet stroke, as well as the supply cylinders of 11½ feet diameter, air receivers, regenerators, &c.; in fact, all of that part of the machinery peculiar to Captain Ericsson, and *patented* by him in the four quarters of the globe. There still remains on board, the shafts, wheels, and cranks, which being of the ordinary kind, may yet be of service. Having virtually abandoned every principle that he claimed, and which he advocated as late as the June number of *Appleton's Magazine*, the question arises, what will he do next? He has sustained himself as the perfector of a new motive power before the community, for the last eighteen months, by the strictest secresy as regards all practical results, and the exclusion from his ship of those capable of judging, and he now finds that those who have been termed by him smatterers have (perhaps through their ignorance) been true *prophets.* It will be a pleasure to those foundries which were unable to make 20 feet cylinders, to be informed that Capt. E., in the new engines now going on board, has concluded to use them of about 6 feet diameter. It will no doubt be a source of regret to the late Secretary of the Navy, who advised Congress to build two ships like the *Ericsson*, to know that the new engines will not admit of *those large double pistons* which, by the reports of Captains Sands and Ericsson, formed a *peculiar feature* of that ship, and insured such regularity of motion. In the new engines, now being put in, the large cylinders will have a diameter of about 6 feet, and the supply cylinders a diameter of about 3½ feet. The same air is to be used at a high pressure over and over again, and is alternately

heated and cooled as it passes through tubes immersed in fire (before it enters the large cylinders,) and water (after it leaves them.) It is presumed that the new machinery will be on board in time to go to Washington before the next Congress adjourns, as it is thought that from the large number of experimental ships that have fallen into the hands of the Navy department in times past, the Government could not do better than make another investment, much to the relief of those unfortunate individuals who have furnished the capital for the present *magnificent experiment.* FULTON.

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*A New Iron and Coal Field.**

A detailed account of the discovery of an extensive coal-field, and of beds of iron-stone, in the county of Leitrim, Ireland, is given in the last number of the *Belfast News Letter*, and appears to indicate a new era of commercial and manufacturing prosperity for that country. It appears that about three miles from Drumkerin, six from Lough Allen, and nine miles south of Manorhamilton, there is a district called Crevelea, upon which operations were commenced last February by a Scotch company, for the purpose of making pig iron. Their mineral take extends to the side of Lough Allen; but their present openings are immediately in the district just named. A gentleman of great experience as a civil engineer, and a member of the British Association, now resident in Belfast, has just visited the scene of these operations, and from a brief memoir which he has made of what he observed, the following extract has been taken. He says:—"I found they had the coals cropping out in various places, consisting of two beds, near each other, each from 2½ to 3 feet in thickness. In proximity to these they have two strata of ironstone, the one in balls from the size of an orange to 18 inches in diameter, both most easily obtainable, and the former particularly of the best kind, being equal to any stone found in the three kingdoms, and both carbonates of iron, from which two tons of the calcined stone will make one ton of pig iron. The coal is a brilliant black, of the utmost value as to its cooking powers, as well as equal to the best coals of South Wales for evaporating steam, and singularly free from sulphur, the indication of which is only 0·5 per cent. I found a good road made, and all the outlay necessary for a blast furnace. An engine of more than 100 horse power, and the furnace, being heated, was to be able to charge in a few days; also large quantities of ore calcined, and coals ready, so soon as the furnace was sufficiently dry to use. From the way in which the coal and ironstone are obtainable, they can be brought to the furnace at about 3s. per ton; and, looking at the quality and the arrangements altogether, I have no hesitation in saying, that they will make iron as cheap, if not cheaper, than in either Scotland or England; and the quality of their pig iron will be second to none, since, with similar materials, this result has ever been insured. I expected a good deal from what I had heard before visiting the place, but it went beyond my expectations, and I returned satisfied that it only requires that district to be opened by railway communication in a very few years to make Leitrim the Staffordshire of Ireland. If such a field of mineral wealth were known

* From the London Mechanics' Magazine, January, 1853.

to exist in any part of England which had no such means of access, I am quite sure a very short time would elapse before it would be at once developed, and its riches made available. I give this opinion as an engineer long acquainted with mineral properties in England, and having no interest, personally, in any property in Leitrim."

The field of these operations is not very far distant from the Arigna Company's works, which have been, unfortunately, discontinued, in consequence of a combination among the workmen. The value of the Arigna ore is indisputable.

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*Trial Trips of the Impérieuse.**

At ten minutes before 2 o'clock on Monday afternoon, the *Impérieuse*, having previously got her steam up, steamed out of the basin by back turns of her screw, and on entering the river immediately started for her trial trip; the screw almost getting up to full speed at starting, and on proceeding down the river the engines worked remarkably well, making up to 68 revolutions per minute with the greatest ease, and causing her to leave the *Monkey* and *African* steam vessels, sent to attend her, far behind. Captain Watson, with all the officers, was on board, and Captain Hood, R. N., with Lieutenant Robertson, of the steam department afloat at Woolwich; Mr. Dinnen, inspector of steam-machinery afloat; Mr. Taplin, second assistant to the chief engineer at Woolwich Dockyard; Mr. John Penn, Mr. Mathew, and Mr. Hartree, of the firm of John Penn and son, the constructors of her engines of 360 horse power, on the "trunk" principle patented by that firm, and so successful in the *Arrogant* steam-frigate; and Mr. F. P. Smith, long connected with the introduction of the screw-propeller, into the naval service.

The *Impérieuse* went down the river in fine style, and ultimately left the *Monkey* and *African* far out of sight. On testing her speed at the measured mile, it was found to be upwards of 10¼ knots per hour, the engines working most satisfactorily, without the slightest symptom of heating or anything going wrong. On casting anchor below Gravesend, all on board were much gratified at the manner in which she was brought up; as, notwithstanding her size, she appears as manageable as a small boat. A glance would at once afford evidence that she is a most powerful vessel, with ample room to mount and work with freedom guns of the largest calibre.

Her armament will consist of eight guns, each 9 feet in length and weighing 65 cwt., with an 8-inch bore, and twenty-two 32-pounders of 56 cwt., and 9 feet 6 inches long each. On the upper deck she will have one pivot gun 95 cwt., and 10 feet in length, for 68-pound shot, or 10-inch shell (already mounted); two 8-inch guns of 65 cwt. each, and eighteen 32-pounders of 45 cwt. each, and 8 feet 6 inches long each.

On the following day the *Impérieuse* had her steam up again shortly after 7 o'clock, and having heaved her anchor, started on a further trial trip between the Nore and Mouse Lights, in the deep water of that channel. She soon left the *Monkey* and *African* steam-vessels far behind, to the surprise of the crews of the numerous craft on the river. She arrived at the Nore at 35 minutes past 9, and finished her trial, running

* From the London Mechanics' Magazine, January, 1853.

the distance of 15 knots and 200 yards from the Nore Light to the Mouse Light and back, at 13 minutes past 11,—showing a speed of 8·927 knots against the tide, which ran very strong, and a speed of 12·420 with the tide, but against a double reef topsail breeze. The average of the run out and back to the Nore was consequently 10·673 knots per hour; the number of strokes of the engines, as counted by a machine in operation during the whole trial, was 67·7 per minute, and an equal number of revolutions of the screw propeller, 16 ft. 6 inches in diameter, and having a pitch of 16 feet. The draft of water of the *Impérieuse* during the trial was 16 feet forward and 18 feet 3 inches aft.

After the trial, the *Impérieuse* was steered for the Medway, and, having taken on board a pilot sent out by the Admiral from the port of Sheerness, she proceeded up that river, and arrived under the sheer hulk at Chatham at 5 minutes past 1 o'clock, P. M., where one of her masts and her bow-sprit where suspended in mid-air ready to be put on board. It is worthy of remark, as unexampled in any previous trials of engines for the first time, that there was not, from the moment the *Impérieuse* left Woolwich until she arrived at Chatham, an engineer's stoppage for one second to adjust any of the screws or other parts of the engines. Everything worked so satisfactorily that the few adjustments required were performed with the greatest ease while at full speed. The only times the engines had to be eased was when the numerous vessels in the river could not get out of her way.

Translated for the Journal of the Franklin Institute.

A New Modeling Clay.

M. Barreswill has prepared for the use of sculptors a modeling clay which does not dry, but remains constantly moist. His process consists in moistening the clay not only with water, but with a concentrated solution of glycerine, a liquid substance which does not dry.—*Cosmos, 20th Feb.*, 1853, *p.* 296.

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*Use of Cast Iron in Boilers.**

Cast iron has been used in France for some time to form the ends of the generators or "bouilleurs" of boilers, as they project beyond the brick setting, and are not exposed to the direct heat of the fire. The use of cast iron for this purpose is now, however, expressly forbidden by a recent order issued from the office of the Minister of Public Works. All boilers in France must be tested to three times the pressure they are intended to bear, and the operation is to be repeated annually. Cylinders of steam engines and steam drying cylinders are tested in a similar manner. It says much for the inspection practised in France, that boiler explosions are of extremely rare occurrence.

Brass Tube-making Machinery.†

A very ingenious machine for making brass tubes without seam, the invention of M. Degrand, has been recently established in France, and

* From the London Artizan, May, 1853. † From the London Mining Journal, No. 920.

promises very excellent results. The tubes are cast in brass, (say) 20 inches long, and of a great thickness. These are then put on steel mandrils, the diameter of which answers to the interior diameter of the finished tube. The tubes on the mandrils are then placed in the machine, and passed between fluted rollers under a considerable pressure. A reciprocating motion is given to the tube on which the mandrils are fixed, and, at the end of each stroke, the tubes are slightly turned round, to expose a fresh surface to the action of rollers. A continuation of this process swages out the short thick tube to a long thin one, of the desired dimensions. A machine under the same patent, has been set to work in England; and having been constructed after the one above mentioned, is still more simple and effectual. Under the ordinary system of making brass tubes, the brass is cut into sheets of the proper size, the alternate edges bevelled off in a planing machine, and the plate is then bent on a mandril with a hammer, and brazed, the bevelled edges forming the joint. The rough ends are then cut off in a lathe, and the tube cleaned with acid to finish it.—*Artizan.*

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, June 16, 1853.

Samuel V. Merrick, President, in the chair.

John F. Frazer, Treasurer.

John E. Addicks, Recording Secretary, pro tem.

The minutes of the last meeting were read and approved.

Letters were read from the Statistical Society, and the Institute of Actuaries, London; Charles F. Stansbury, Esq., Washington City, D. C.; Trustees of the City Library of New Bedford, Mass., and the Maryland Institute, Baltimore, Maryland.

Donations to the Library were received from Her Majesty's Commissioners for the Exhibition of the Works of Industry of all Nations (through C. F. Stansbury, Esq.;) The Society of Arts and the Institutions in Union, and John Weale, Esq., London; J. R. Snyder, Chairman of the Committee on the Geology of the State of California; Major J. J. Stevens, U. S. Coast Survey, Washington City, D. C.; The Long Island Railroad Co., New York; Trustees New Bedford City Library, Mass., and A. Hart, Prof. J. F. Frazer, and Edward Miller, Jr., Philadelphia.

The Periodicals received in exchange for the Journal of the Institute were laid on the table.

The Treasurer read his statement of the receipts and payments for the month of May.

The Board of Managers and Standing Committees reported their minutes.

The Board of Managers reported that Solomon W. Roberts, Esq., had, owing to his continued absence from the City on professional services, at the last meeting resigned his office as Corresponding Secretary of the Institute, and that they had unanimously elected Professor John C. Cresson to fill the vacancy.

The Board further reported that they had elected W. J. Marshall, Esq., Secretary of the Institute of Mechanical Engineers, Birmingham, England, a corresponding member of the Franklin Institute.

New candidates for membership in the Institute (3) were proposed, and the candidates (3) proposed at the last meeting were duly elected.

Mr. Fairman Rogers exhibited a level staff somewhat similar to one described in vol. XIX. of the *Journal*, p. 78. It is intended to dispense with the ordinary sliding target, and to remedy some of the inconveniences attending the use of the ordinary "Gravatt staff." The divisions in tenths and hundredths of a foot are not placed over each other, but diagonally across the face of the rod, forming a species of diagonal scale. The first five-hundredths in every tenth are marked by diamonds ·04 long, and the remaining five-tenths by dots. The feet are marked by red Roman numerals. This rod can be read 400 feet with a good 14 inch level, and appears to be quite as accurate as any other form. Its principal convenience consists in the fact that the leveller need not depend upon the rodman's reading, as he reads the graduations himself. It is decidedly the best form of staff without a target yet presented, yet the old target rod will probably be found, on the whole, more convenient, from its greater distinctness at long distances and in thick woods.

Mr. Jason M. Mahan exhibited an improved machine for planing off the backs of stereotype plates.

Dr. L. V. Newton made some remarks on his galvanized type, stating that experience had confirmed the favorable estimate in which it was held at the time he had previously presented it to the notice of the Institute, in March 20th, 1851, (see *Journal Institute*, Vol. XXI, 3d Series, p. 281.)

Dr. Alfred Kennedy exhibited a small surgical instrument for cauterizing. It consisted of two brass wires imbedded in a varnished cocoa wood case, and connected at the lesser extremity by a small platinum wire, rather finer than bell wire, bent in the form of the letter *y*. The bottom of the *y* was the cauterizing portion, and when required for use was heated by a current of galvanism from a battery, the conducting wires of which were attached to the instrument by thumb screws in the usual way. Dr. Kennedy had seen this cautery used in the service of M. Nelaton, at Paris, in August, 1851, and from a drawing taken at the time, Mr. L. C. Francis, philosophical instrument maker, of this city, had made that now exhibited, which was about the size of one's finger.

The heating effect of a current of galvanism through a fine wire of platinum had been applied in terrestrial and in sub-marine blasting. Dr. Hare had also ingeniously employed it in his eudiometer. This was one of its applications to surgery, and nothing could be simpler than its employment. The projecting wire was brought close to the part to be cauterized, an assistant at a signal given made the connexion with the battery, the platinum immediately became incandescent, the part was cauterized; at another signal the connexion was broken, and the instrument withdrawn cold.

In deep seated ulcers, in the posterior portion of the mouth, for example, the galvanic cautery possessed unequalled advantages. Unlike the actual cautery heated by flame, it excites no alarm in the patient, and

may even be used without his knowing what burns him. In large serous tumours, as in "white swelling" of the knee, the instrument is inconvenient from the large battery required. In a case of that disease in which it was tried, three half gallon Bunsen batteries failed to heat sufficiently to prevent the chilling of the wire as it was passed over the extended surface of the enormous watery swelling. For the smaller operations, the instrument must be classed among the many valuable contributions of chemistry to surgery.

COMMITTEE ON SCIENCE AND THE ARTS.

Report on Mr. Thomas Armitage's Lightning Rod.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination, "a Lightning Rod," invented by Mr. Thomas Armitage, of Philadelphia, Pennsylvania—Report:

The lightning rod of Mr. Armitage differs from that ordinarily in use, by the substitution of a pointed magnet for the purpose of discharging the electricity from the clouds, in the use of a number of points for a peculiar purpose, and in so adjusting the magnet with its appendages that it may always be directed towards the point from which the storm is proceeding. Its construction is as follows:

The usual metal rod is extended from the ground to the top of the building to be protected, where it terminates in a number of iron points, which are painted for the purpose of preventing rusting. A few feet below this termination, a cross piece of iron works freely by means of a collar upon the upright rod, and carries at one end the magnet surrounded by points, while at its other extremity it bears ornamental figures of sheet iron, exposing sufficient surface to cause it to operate as a weathercock, thus keeping the magnet always turned to the quarter from which the wind is blowing.

The steel, before being magnetized, is made to undergo a tedious process, the nature of which was not fully explained to the Committee, with the object of preventing it from rusting; it is then magnetized by subjecting it to a galvanic current. In the specimens submitted to the Committee, the magnetism communicated was very feeble, so much so as to lead Mr. Armitage to the belief that it was of a peculiar nature, having an attraction for iron, but not for steel, and presenting but one pole, and that of a different nature from either of those of ordinary magnets. The Committee of course demonstrated to him the errors in these views.

The supposition that this lightning rod is more efficient than the ordinary one, rests on the belief that a magnet exerts a greater attraction for electricity than a piece of platina, or other metal. As Mr. Armitage stated that experiments made by himself, in conjunction with another gentleman, had shown this to be the fact, the Committee felt of course bound to endeavor to confirm or confute this opinion by direct observation; and a course of experiments was in consequence instituted, in which the distance was determined at which the spark from the prime-conductor of an electrical machine could be taken by the same piece of iron, at one time un-

magnetized, and at another highly magnetized by the influence of the galvanic coil. This distance was found to be the same. The distance at which a point would prevent the accumulation of electricity in the conductor (as indicated by a quadrant electrometer placed upon it) was then tried, and found to be the same, whether the point was magnetic or not. They therefore believe that the opinion of Mr. Armitage, that a magnetic point will give greater security from the effects of lightning than an ordinary one, is fallacious.

Mr. Armitage has surrounded his magnet with a brush of iron points, and terminated the vertical point of his rod with a similar brush, believing that through them the electricity which enters by the magnet will be again dissipated. It is scarcely necessary for the Committee to advert to the error of this belief. The brush, which is undoubtedly the most effective termination of a lightning rod, loses in his rod very much of its efficiency by being thickly covered with a coating of paint, to preserve the points from rusting.

The idea of presenting the point always towards the storm is in itself excellent, but it is accomplished in this rod only by breaking the perfect metallic connexion which ought to exist between all its parts; which break might perhaps lead to accident, and must undoubtedly diminish the inductive efficiency of the point, when by the accumulation of rust at the collar, a bad conductor of electricity is interposed between the magnet and the ground. The same advantage is fully gained by terminating the ordinary lightning rod by a ring or brush of points of platina wire, pointing in all directions.

In conclusion, therefore, the Committee cannot approve of the method of constructing lightning rods proposed by Mr. Armitage:

First, Because they do not believe that the magnet is in the least more efficient in discharging the electricity of the thunder cloud, than an ordinary metallic point.

Second, The efficiency of the point is reduced by the want of perfect metallic connexion between it and the ground.

For these reasons, the Committee believe that the lightning rods thus constructed are decidedly inferior to those commonly used.

By order of the Committee,

Wm. Hamilton, *Actuary.*

Philadelphia, June 8, 1853.

BIBLIOGRAPHICAL NOTICES.

Elements of Mechanics: elucidating the Scientific Principles of the Practical Construction of Machines. By T. Baker, C. E. London: John Weale, 1852.

This is a little book which will be found very valuable to young mechanics and inventors, intended as it is to give them an account of the various contrivances which have been devised for the purpose of modifying motion so as to suit it to particular purposes. The mechanical principles announced at the beginning are by no means as clearly laid

down as they should be, and are, we think, liable in some cases to misapprehension; but the arithmetical examples, if carefully studied, will correct this, and the description of the contrivances and the accompanying drawings are very clear and satisfactory.

At the end there are a number of articles on sugar refining, pot-making, &c., &c., which are altogether out of place, and seem to be in the nature of advertisements. They have the disadvantage of making the book larger than it otherwise would be, and will probably be but of little use to the persons for whom the main part of the volume is intended. But, on the other hand, they will interest another class of readers, who will be glad to find anywhere the information here given, and the study of them will surely hurt nobody.

Something of the same kind may be said of the constant references to Professor Willis's *Principles of Mechanism;* they may lead the learner to the belief that the said Professor is a very great genius, and the inventor of almost every thing useful in the mechanical arts; but if the reader is thus induced to purchase and study the book referred to, he will find it well worth his money and trouble, and his farther study of mechanics will probably teach him that there have been other men great in this line besides the Professor; if it does not, there is no great harm done; if it does, he may think better of others, and none the worse of Professor Willis.

Plain Directions for obtaining Photographic Pictures by the Calotype and Energiatype; also, upon Albumenized Paper and Glass, by Collodion and Albumen, &c., &c. Philadelphia: A. Hart, late Carey & Hart, 1853.

This book is intended to give those beginning the study of Photography (using the word in its largest sense) a practical insight into the methods and manipulations by which the various kinds of pictures now in vogue are produced. It makes apparently no higher pretensions than to be a compilation of descriptions of methods mostly by the authors themselves, and so far as we are able to judge, from a very limited experience in making pictures, will prove to be a valuable manual for the photographer. There is no apparent attempt made to give credit where it is due for improvements or inventions, and the author of one of the treatises is especially unjust in his allusion (p. 150) to the process of Mr. Hill. It is mere justice to the gentleman slandered to say, that his claims do by no means "rest pretty much on his own assertions." On the contrary, he had, before any publication was made, shown the pictures to some of our best artists, and has since submitted them to a Committee of the United States Senate. Our English brethren must pardon us for believing that this is as good evidence of a fact as the understanding "that specimens have been forwarded to London."

The first original inventor in this line is M. Becquerel, who showed his pictures to the Academy of Science at Paris, and published his process. M. Niepcé, Mr. Hill, and doubtless others, have independently arrived at still better results, and deserve credit for what they have done. But in giving this credit to one, it is not necessary to do injustice to, much less to sneer at, the other.

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Contents for July, 1853.

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JOURNAL

OF THE

FRANKLIN INSTITUTE

OF THE

State of Pennsylvania,

FOR THE PROMOTION OF THE MECHANIC ARTS.

DEVOTED TO

Mechanical and Physical Science,

CIVIL ENGINEERING, THE ARTS AND MANUFACTURES,

AND THE RECORDING OF

American and other Patented Inventions.

EDITED BY

JOHN F. FRAZER.

Assisted by the Committee on Publications of the Franklin Institute.

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Of the State of Pennsylvania,

FOR THE PROMOTION OF THE MECHANIC ARTS.

The Journal of the Franklin Institute is the oldest Periodical in the United States devoted to the spread of information on subjects connected with the Mechanic and Manufacturing Arts, and the only one containing a complete record of American Patents issued since its establishment in January, 1826.

The extensive list of European Exchanges which it possesses, enables it to give to its readers early information as to any improvements, or discoveries made in any part of Europe, while it ensures to articles published in its pages, a wide circulation in those Countries of the Old World in which Mechanic Arts and Manufactures prosper.

Among its correspondents will be found many of the most distinguished artizans and scientific men of our own Country; and in it will be found the official accounts of many important experimental researches, conducted under authority of the Institute or other public bodies. A liberal compensation is offered by the Committee for all original articles within its scope; and manufacturing firms are respectfully solicited to forward to the Actuary such details as they may deem suitable, of mechanical processes, machinery, steam vessels, and other engineering works in process of construction.

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In founding this Journal, the Franklin Institute was not governed by any desire of pecuniary profit, but solely by the wish to give American Mechanics useful information as to the progress, both in this Country and in Europe, of the Arts and the Sciences upon which they are founded. As the whole income derived from it is expended in its publication, its further improvement and illustration must necessarily depend on obtaining an increase of its subscription list. With a view to promote such improvement and increase its self-sustaining ability, the Committee on Publications has decided to make a very considerable reduction in the subscription price of the Journal, in such a manner as may offer an inducement to present subscribers to lend their aid in obtaining for it an increased circulation.

They therefore propose to forward, *free of postage*, two copies for one year to any present subscriber who shall send the name of one new subscriber, and remit the sum of Eight Dollars. And, in like manner, to forward three copies to any subscriber who shall send the names of two new subscribers and Ten Dollars. A club of new subscribers remitting to the Actuary, Eight Dollars, will be furnished with two copies for one year, and for Ten Dollars three copies for one year.

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JOURNAL

OF

THE FRANKLIN INSTITUTE

OF THE STATE OF PENNSYLVANIA

FOR THE

PROMOTION OF THE MECHANIC ARTS.

AUGUST, 1853.

CIVIL ENGINEERING.

On Boilers and Boiler Explosions. By W. Fairbairn, Esq., F. R. S.*

Various notions are entertained as to the causes of boiler explosions, and scientific men are not always agreed as to whether they arise from excessive pressure due to the accumulation of heat, or to some other cause, such as the explosion of hydrogen gas, generated by the decomposition of water suddenly thrown on heated plates, of which we have an exceedingly indefinite conception. That of the decomposition of water is, I believe, a somewhat prevalent opinion, but I apprehend it cannot be the invariable cause, inasmuch as in that case we must assume the boiler to be nearly empty of water, and the plates over the furnace red hot.

It is not unreasonable to suppose, that a force of such sudden origin, and so immediate and destructive in its effects, should suggest the presence of an explosive mixture; but I think it will be difficult, if not impossible, to account for the accumulation of a sufficient quantity of hydrogen without the presence of oxygen and other gases, in their due proportions, to form an explosive compound. Now, as these equivalents cannot be generated all at once by the simple decomposition of water (admitting for the moment that the water is decomposed), we must look for some other cause for the fatal and destructive accidents which, of late years, have been so prevalent.

In treating of this subject, I hope to show not only what are the probable causes of explosion, but what appears equally important, what are

* From the London Practical Mechanic's Journal, June, 1853.

not the causes. So many theories (some of them exceedingly problematical) have been brought forward on the occasion of disastrous explosions, that it requires the utmost care and attention to circumstances before they are generally admitted. To acquire satisfactory evidence as to the precise condition of the boiler and furnaces before an explosion is next to impossible, as most frequently the parties in charge, and from whose mismanagement and neglect we may, in many cases, date the origin of the occurrence, are the first to become the victims of their own indiscretion, and we can only judge from the havoc and devastation that ensues as to the immediate cause of the event.

From this it follows that, in many of the explosions on record, few, if any, of the real circumstances of the case are made known, and we are left to draw conclusions from the appearance of the ruptured parts, and the terrific consequences which too frequently follow as a result. This want of evidence as to the precise condition of a boiler, with all its valves and mountings, preceding an explosion, is much to be regretted, as it causes a degree of mystery to surround the whole transaction; and the vague and sometimes inaccurate testimony of witnesses, but too often baffles all attempts at research, and creates additional cause of alarm to all those exposed to the occurrence of similar dangers.

In the discussion of this subject, I shall, however, endeavor to trace, from a number of examples in which I have been personally engaged, and from others which have come to my knowledge, the causes which have led to the disastrous effects.

In my attempts to ascertain facts by a course of reasoning which I shall have to follow in this investigation, I could wish it to be understood that it is not my intention to raise doubts and fears in the public mind, calculated to arrest the progress of commercial enterprise, or to cripple the energies of mechanical skill. On the contrary, I am most anxious to promote the advancement of the useful arts, to increase our confidence in the application of increased pressure, and to secure, within moderate bounds, the economical and useful employment of one of the most powerful agents ever known in the history of practical science. My object in this inquiry will, therefore, be to enlarge our sphere of action by a more comprehensive knowledge of the subject on which it treats; to induce greater caution along with improved construction; and to insure confidence in all those requirements essential to the public security.

For the attainment of these objects, it will be necessary to divide the subject into the following heads:—

1*st*, Boiler explosions arising from accumulated internal pressure;
2*d*, Explosions from deficiency of water;
3*d*, Explosions produced from collapse;
4*th*, Explosions from defective construction;
5*th*, Explosions arising from mismanagement or ignorance; and,
6*th*, The remedies applicable for the prevention of these accidents.

1*st*, *Boiler explosions arising from accumulated internal pressure.*—In nine cases out of ten, a continuous increasing pressure of steam, without the means of escape, is probably the immediate cause of explosion; in some instances it arises from deficiency of water, but accidents of this kind are comparatively few in number, as we often find in tracing the

causes, that they have their origin in undue pressure, emanating from progressive accumulation of steam of great force and intensity. Let us take an example—to some of which I am able to refer—and we shall find that a boiler, under the influences of a furnace in active combustion (as the recipient of heat), will generate an immense quantity of steam, and unless this is carried off by the safety-valve, or the usual channels, when generated, the greatest danger may be apprehended by the continuous increase of pressure that is taking place within the boiler. Suppose that, from some cause, the steam thus accumulated does not escape with the same rapidity with which it is generated; that the safety-valves are either inadequate to the full discharge of the surplus steam, or that they are entirely inoperative, which is sometimes the case, and we have at once the clue to the injurious consequences, which, as a matter of fact, are sure to follow. The event may be procrastinated, and repeated trials of the antagonist forces from within, and the resistance of the plates from without, may occur without any apparent danger; but these experiments, often repeated, will at length injure the resisting powers of the material, and the ultimatum will be the arrival of the fatal moment, when the balance of the two forces is destroyed, and explosion ensues. How very often do we find this to be the true cause of accidents arising from extreme internal pressure, and how very easily these accidents might be avoided by the attachment of proper safety-valves to allow the steam to escape, and relieve the boiler of those severe trials which ultimately lead to destruction! If a boiler, whose generative power be equal to 100, be worked at a pressure of 10 lbs. on the square inch, the area of the safety-valves should also be equal to 100, in order to prevent a continuous increase of pressure; or in case of the adhesion of any of the valves, it is desirable that their areas should, collectively, be equal to 100. If two or more valves are used, 100 or 120 would then be the measure of outlet. Under these precautions, and a boiler so constructed, the risk of accident is greatly diminished; and provided one of the valves is kept in working order, beyond the reach of interference by the engineer, *or any other person*, we may venture to assume that the means of escape are at hand, irrespective of the temporary stoppage of the usual channels for carrying off the steam.

So many accidents have occurred from this cause—the defective state of the safety-valves—that I must request attention whilst I enumerate a few of the most prominent cases that have come before me. In the year 1845, a tremendous explosion took place at a cotton-mill in Bolton. The boilers, three in number, were situated under the mill, and from unequal capacity in the safety-valves, and even those imperfect, as they were probably fast, a terrific explosion of the weakest boiler took place, which tore up the plates along the bottom, and the steam having no outlet at the top, not only burst out the end next the furnace, demolishing the building in that direction, but tearing up the top on the opposite side, the boiler was projected upwards in an oblique direction, carrying the floors, walls, and every other obstruction before it; ultimately it lodged itself across the railway at some distance from the building. Looking at the disastrous consequences of this accident, and the number of persons—from sixteen to eighteen—who lost their lives on the occasion, it became a subject of deep

interest to the community that a close investigation should immediately be instituted, and a recommendation followed, that every precaution should be used in the construction as well as the management of boilers.

The next fatal occurrence on record in this district was a boiler at Ashton-under-Lyne, which exploded under similar circumstances, namely, from excessive interior pressure, when four or five lives were lost; and again, at Hyde, where a similar accident occurred from the same cause, which was afterwards traced to the insane act of the stoker or engineer, who prevented all means for the steam to escape by tying down the safety-valve.

There was a boiler exploded at Malaga, in Spain, some years since, and my reason for noticing it in this place is to show, that explosions may be apprehended from other causes than those enumerated in the divisions of this inquiry, and that is *incrustation*. Dr. Ritterbrandt says in a paper read before the Institution of Civil Engineers, by an eminent chemist, Mr. West, "that a sudden evolution of steam, under circumstances of incrustation, is no uncommon occurrence." In several instances I have known this to be the case, particularly in marine boilers, where the incrustation from salt water becomes a serious grievance, either as regards the duration of the boiler, or the economy of fuel.

If it were supposed, as Dr. Ritterbrandt observes, that the boiler was incrusted to the extent of half an inch, it would at once be seen that nothing was more easy than to heat the boiler strongly, even to a red heat, without the immediate contact of water. Under these circumstances, the hardened deposits being firmly attached to the plates, and forming an imperfect conductor of heat, would greatly increase the temperature of the iron; and the great difference of temperature thus induced between the material, and the greater expansibility of the iron, would cause the incrustation to separate from the plates, and the water rushing in between them would generate a considerable charge of highly elastic steam, and thus endanger the security of the boiler.

These phenomena were singularly exemplified in the Malaga explosion, which is thus described by Mr. Hick:—"I have ascertained that a very thick incrustation of salt was found on the lower part of the boiler, immediately over the fire, and, so far as it extended, the plates appear to have been red hot, thereby much weakened, and hence the explosion. The ordinary working pressure of the boiler is 130 lbs. per square inch, and perhaps at the time of the explosion very much above that pressure, as there was only one small safety-valve of two and a half inches diameter. The boiler was only two feet six inches diameter, and twenty feet long."

Incrustation, exclusive of being dangerous, is attended with great expense and injury to the boiler by its removal. In the case of Translantic, Oriental, or other long sea-going vessels—even after the use of brine-pumps, blowing out, &c.—a very large amount of incrustation is formed, and considerable sums of money are expended each voyage to remove it.

Other explosions, of a more recent date, are those which occurred at Bradford and Halifax. They are still fresh in the recollection of the public mind, and are so well known as not to require notice in this place.

I cannot, however, leave this part of the subject without reverting to

an accident which occurred on the Lancashire and Yorkshire Railway, which had its origin in the same cause—excessive internal pressure. This accident is the more peculiar, as it led to a long mathematical disquisition as to the nature of the forces which produced results at once curious and interesting. The conclusions which I arrived at, although *practically right, were, however, considered by some mathematically wrong*, as they were firmly combated by several eminent mathematicians; and notwithstanding the number of algebraic formulas, and the learned discussions of my friends on that occasion, I have been unable to change the opinions I then formed to others more conclusive.

The accident here alluded to occurred to the "Irk" locomotive engine, which in February, 1845, blew up, and killed the driver, stoker, and another person who was standing near the spot at the time. A great difference of opinion as to the cause of this accident was prevalent in the minds of those who witnessed the explosion, some attributing it to a crack in the copper fire-box, and others to the weakness of the stays over the top; neither of these opinions were, however, correct, as it was afterwards demonstrated that the material was not only entirely free from cracks and flaws, but the stays were proved sufficient to resist a pressure of 150 to 200 lbs. on the square inch. The true cause was afterwards ascertained to arise from the fastening down of the safety-valve of the engine (an active fire being in operation under the boiler at the time), which was under the shed, with the steam up, ready to start with the early morning train.

The effect of this was the forcing down of the top of the copper fire-box upon the blazing embers of the furnace, which, acting upon the principle of the rocket, elevated the boiler and engine, of 20 tons weight, to a height of 30 feet, which, in its ascent, made a somerset in the air, passed through the roof of the shed, and ultimately landed at a distance of 60 yards from its original position. The question which excited most interest, was the absolute force required to fracture the fire-box, its peculiar properties when once liberated, and the elastic or continuous powers in operation, which forced the engine from its place to an elevation of 30 feet from the position on which it stood. An elaborate mathematical discussion ensued, relative to the nature of these forces, which ended in the opinion that a pressure sufficient to rupture the fire-box, was, by its continuous action, sufficient to elevate the boiler, and produce the results which followed. Another reason was assigned, namely, that an accumulated force of elastic vapor at a high temperature, with no outlet through the valves, having suddenly burst upon the glowing embers of the furnace, would charge the products of combustion with their equivalents of oxygen, and hence explosion followed. Whether one or both of these two causes were in operation is probably difficult to determine; at all events, we have in many instances precisely the same results produced from similar causes, and unless greater precaution is used in the prevention of excessive pressure, we may naturally expect a repetition of the same fatal results.

The preventives against accidents of this kind are well-constructed boilers of the strongest form, and duly proportioned safety-valves, one under the immediate control of the engineer, and the other, as a reserve, under the keeping of some competent authority.

2d. Explosions from deficiency of water.

This division of the subject requires the utmost care and attention, as the circumstance of boilers being short of water is no unusual occurrence. Imminent danger frequently arises from this cause, and it cannot be too forcibly impressed upon the minds of engineers, that there is no part of the apparatus which constitutes the mountings of a boiler which require greater attention—probably the safety-valves not excepted—than that which supplies it with water. A well-constructed pump and self-acting feeders—when boilers are worked at a low pressure—are indispensable; and where the latter cannot be applied, the glass tubular gauge steam and water cocks must have more than ordinary attention.

In a properly constructed boiler, every part of the metal exposed to the direct action of the fire should be in immediate contact with the water, and when proper provision is made to maintain the water at a uniform height and depth above the plates, accidents can never occur from this cause.

Should the water, however, get low from defects in the pump, or any stoppage of the regulating feed-valves, and the plates over the furnace become red hot, we then risk the bursting of the boiler, even at the ordinary working pressure. We have no occasion, under such circumstances, to search for another cause, from the fact that the material when raised to a red heat has lost above five-sixths of its strength, and a force of less than one-sixth will be found amply sufficient to bear down the plates directly upon the fire, or to burst the boiler.

When a boiler becomes short of water, the first, and perhaps the most natural action is, to run to the feed-valve, and pull it wide open. This certainly remedies the deficiency, but increases the danger, by suddenly pouring upon the incandescent plates a large body of water, which, coming in contact with a reservoir of intense heat, is calculated to produce highly elastic steam. This has been hitherto controverted by several eminent chemists and philosophers; but I make no doubt such is the case, unless the pressure has forced the plates into a concave shape, which, for a time, would retard the evaporization of the water when suddenly thrown upon them. Some curious experimental facts have been elicted on this subject, and those of M. Boutigney and Professor Bowman, of King's College, London, show that a small quantity of water projected upon a hot plate does not touch it; that it forms itself into a globule, surrounded by a thin film, and rolls about upon the plate without the least appearance of evaporation. A repulsive action takes place, and these phenomena are explained upon the supposition that the spheroid has a perfectly reflecting surface, and consequently the heat of the incandescent plate is reflected back upon it. What is, however, the most extraordinary in these experiments is the fact, that the globule, whilst rolling upon a red-hot plate, never exceeds a temperature of about 204° of Fahrenheit; and, in order to produce ebullition, it is necessary to cool the plate until the water begins to boil, when it is rapidly dissipated in steam.

The experiments by the committee of the Franklin Institute on this subject, give some interesting and useful results. That committee found that the temperature of clean iron, at which it vaporized drops of water, was 334° Fahrenheit. The developement of a repulsive force, which I have endeavored to describe, was, however, so rapid above that temper-

ature, that drops which required but one second of time to disappear at the temperature of maximum vaporization, required 152 seconds when the metal was heated to 395° of Fahrenheit. The committee goes on to state that—"One ounce of water introdued into an iron bowl three-sixteenths of an inch thick, and supplied with heat by an oil-bath at the temperature of 546°, was vaporized in fifteen seconds, while at the initial temperature of 507°, that of the most rapid evaporization was thirteen seconds."

The cooling effect of the metal is here strikingly exemplified by the increased rapidity of the evaporization, which, at a reduced temperature of 38°, is effected in thirteen instead of fifteen seconds.

This does not, however, hold good in every case, as an increased quantity of water, say from one-eighth of an ounce to two ounces, thrown upon heated plates, raised the temperature of its vaporation from 460° to 600° Fahrenheit; thus clearly showing that the time required for the generation of explosive steam, under these circumstances, is attended with danger, and it may be doubted whether the ordinary safety-valves may not be wholly inadequate for its escape.

Numerous examples may be quoted to show that explosions from deficiency of water, although less frequent than those arising from undue pressure, are by no means uncommon; they are, nevertheless, comparatively fewer in number, and the preventives are good pumps, self-acting feeders (when they can be applied), and all those conveniences, such as water-cocks, water-gauges, floats, alarms, and other indicators of the loss and reduction of water in the boiler.

To be Continued.

For the Journal of the Franklin Institute.

Thicknesses of Arches. By Charles Ellet, Jr., Civ. Eng.

In some investigations on the equilibrium of arches, made many years ago, I deduced the following simple and convenient rule for determining the proper depth or thickness of the voussoirs of a cut stone arch at the crown.

I am not sure that I ever published the formula, though I have applied it in numerous works.

Let s represent the span of the arch, and T the thickness at the crown.

$$\text{Then } T = \frac{3}{8}\sqrt{s}.$$

or, *the depth of the voussoir at the crown, will be three-eighths the square root of the span.*

This simple rule is applicable to all arches, however great or however small the span, from a semi-circle, to the flatest segments ever attempted on public works. *It is always safe.*

I communicate the formula for the convenience of those who have no better rule to guide them.

Bath Alum, Va., June 28, 1853.

AMERICAN PATENTS.

List of American Patents which issued from June 14th, to July 12th, 1853, (inclusive,) with Exemplifications by Charles M. Keller, *late Chief Examiner of Patents in the U. S. Patent Office.*

JUNE 14.

18. For an *Improvement in mode of Cutting Tenons;* Charles B. Fitch, Galena, Ill.

Claim.—"What I claim is, the method herein described of cutting tenons, by means of the scoring V shaped cutter, that cuts the square shoulder and point, and at the same time scores the side of the tenon, when this is combined with the lancet shaped, or other finishing cutter, for removing the material left by the scorers; the whole arranged and combined in the manner specified."

19. For an *Improvement in Harvesters of Grain and Grass;* William G. Huyett, Williamsburg, Pennsylvania.

Claim.—"I do not claim two series of movable knives or cutters, independent of the arrangement herein shown and described, for they have been previously used; but what I do claim as new is, the peculiar manner of arranging the two sets or series of knives, *b, c,* as herein shown and described, viz: the knives, *b,* being of triangular form, or saw shaped, and having a reciprocating motion, and the knives, *c,* working directly over the knives, *b*; said knives, *c,* being attached by pivots to the outer ends of the teeth, and having an opposite reciprocating motion, communicated to them at their inner ends, by the lever and cross bar, by which arrangement a drawing cut is obtained, and the knives effectually prevented from clogging and choking by the grass or straw."

20. For an *Improvement in Stoves;* S. S. Jewett and F. H. Root, Buffalo, New York, ante-dated December 14, 1852.

Claim.—"We do not claim the furnace or fire place of a stove or grate; nor merely making the door which closes the front thereof, to open and close by sliding, whether the same slides horizontally or vertically; nor making it slide on a ledge on the outside of the stove, nor into and out of the flues; but what we do claim is, the combination, in a stove or grate, of the fire place or furnace, with a sliding door or doors to close the front of the fire place, and a recess in one or both of the jambs of the fire place, for the door or doors to slide into, and be concealed from view on the outside, and be insulated from the fire and smoke within; this recess being a separate compartment, open only where the door enters, and only of sufficient capacity to receive the same, substantially in the manner and for the purposes herein set forth."

21. For an *Improvement in Mop Heads;* Harvey Murch, Lebanon, New Hampshire.

Claim.—"What I claim is, my improved mop head, composed of the fixed cross-head, which has grooves in its lower side and end, in combination with the sliding binder, that terminates in a notched shank and passes through the loop on the handle, which serves as a detent, in consequence of the action of the spring on the under side of the said shank, substantially as herein set forth."

22. For an *Improvement in the Manufacture of Metal Tubes;* George F. Muntz, Jr., Birmingham, England; patented in England, May 8, 1852.

"My invention consists of casting short tubes of a peculiar form or section, rolling them flat, to extend them in length, and then opening them out and rendering them cylindrical, as hereafter explained."

Claim.—"What I claim is, the mode or process of manufacturing a metallic tube, of Muntz's metal, or other like metal or composition of metals, viz: by first casting the metal in a short tube, of the form substantially as represented in figure 1; next heating it as described, and rolling it flat, essentially as exhibited in figure 2, and elongating it at the same time; and finally, opening it out and removing the surplus portions, or fins, and reducing it to its final form, in transverse section, as herein before specified."

23. For an *Improvement in Self Waiting Dining Tables;* Lea Pusey, Patterson, Pa.

Claim.—"What I claim is, a self waiting table, constructed and arranged substantially as described, viz: having an endless band, situated beneath the table and kept in constant

motion, during meals, (by any power, applied through the crank or other means,) to which band is firmly attached, at convenient distances apart, guiding carriers, which pass up through, and are supported by small railway trucks, and move in guiding apertures in the top of the table, and upon the tops of which are placed waiters, whereon dishes are put, and constantly conveyed around, before the guests, on both sides of the table, in combination with the said endless band conveyors. I also claim placing an additional shelf, or second table, over the central portion of the table, above the waiters, for the purpose of holding castors, &c., which do not require to be frequently removed or replaced, substantially as herein set forth."

24. For an *Improvement in Mortising Machines;* Fergus Purden, Baltimore, Md.

"The nature of my invention consists in making the bed piece in two parts, so that it may be adjusted to mortises, in different positions and of various widths, to allow the chips to escape from the under side of the piece mortised."

Claim.—"I do not claim a divided bed, such as has been used heretofore; but what I do claim is, a divided bed so constructed, that it can be adjusted to suit the widths of the mortise to be cut, so as to prevent the side of the mortise from being splintered by the cutter, or chips, when they are forced through, and driven out on the under side, substantially as described."

25. For an *Improvement in Brick Machines;* Alexander H. Sampson, New Orleans, Louisiana.

Claim.—"What I claim is, the box or reservoir of platforms, with the carrying chains, or their equivalents, provided with suitable projections, for catching, drawing forward, and carrying immediately underneath the delivery follower, the boards or platforms for receiving the pressed brick, and by which they are conveyed out of the machine, substantially as described."

26. For an *Improvement in Copying Presses;* E. H. Smith, City of New York.

Claim.—"What I claim is, 1st, The employment of the hand lever, to operate the pressing platen, through the agency or by means of the sliding transverse bar, or its equivalent, in combination with the adjustable stop, or any other mechanical device substantially the same. 2d, The arrangement of the plates, or platens, in such relation to their support and operating medium, as to render three of the four edges of each platen unobstructed perfectly available, and easy of access."

27. For an *Improvement in Type Casting Machines;* John J. Sturgis, City of N. York.

Claim.—"What I claim is, 1st, The use of the horizontal mould block rest, in combination with the vertical and horizontal rock shafts and cam, for the purpose of obtaining a motion of the mould block as nearly horizontal as practicable, substantially as set forth. 2d, The use of the lever and rod in combination with the horizontal mould block rest and matrix, substantially as set forth. 3d, The use of the matrix holder, having a slot in it, to allow of a lifting motion on its centre pin, and a notch in its back side, for the end of a spring to act against, in combination with the spring, inclined plane or cam, on the horizontal rock shaft and pin, for holding it, substantially as set forth. 4th, The V shaped bar secured to an adjustable end plate, attached to the outer end of the lower half of the mould block, in combination with the upper half of the mould block, for the purposes substantially as set forth."

28. For an *Improvement in Cooking Stoves;* Giles F. Filley, St. Louis, Missouri.

Claim.—"What I claim is, 1st, The flaring enlargement of the side flues, from the space above the oven to the flue space, which extends under the entire front end of the oven; and also the enlargement of the central flues F and G, from the said flue space to the upper end of G, for the purpose of increasing the draft of all the flues, and causing a larger portion of heat to be conducted into the said flue space, substantially as herein set forth. In combination with the flaring shape of the flues, F G, I also claim the auxiliary dumb flue, which rises from the flue space, to the hearth plate, and thence is continued immediately under the fire chamber, and up the back of the same, by which another portion of heat from the fire chamber is conducted, by radiation and circulation, into the said flue space, for the purpose of aiding in giving an increased draft to the stove, and in raising the temperature of the front end of the oven bottom to the required degree for baking purposes, substantially as herein set forth."

29. For an *Improvement in Manufacturing Glass;* James M. Brookfield and Ephraim V. White, Honesdale, Pennsylvania, (and Jacob Fatz, having been decided to be a joint inventor with said White,) the said Fatz and White, Assignors to Andrew A. Hay and James M. Brookfield.

"The nature of our invention consists in combining and using a blast, with the ordinary furnace, and anthracite coal as a fuel, for melting the materials in the manufacture of glass.

Claim.—"What we claim is, the application of a blast, and anthracite coal as a fuel, in the manufacture of glass, as herein set forth."

30. For an *Improvement in Moulding Gutta Percha Stereotype Plates;* John L. Kingsley, City of New York.

Claim.—"What I claim is, 1st, The process of expelling air from the surface of the type when forming the mould, and from the surface of the mould when forming the plate, substantially in the manner set forth, or in any equivalent way. 2d, The method described, or its equivalent, of dressing, leveling, or thicknessing the moulds or plates, when made of gutta percha, or compounds that run, so that all the plates made shall be invariably of the same thickness; all of which is herein fully described and set forth."

31. For an *Improvement in Manufacture of Plate Glass;* John J. Greenough, Boston, Massachusetts.

Claim.—"What I claim as my invention is, 1st, Manufacturing plates of glass, by causing the glass, while in a plastic state, to pass between two or more pairs of rollers, substantially in the manner and for the purpose set forth. I also claim embossing the surfaces of plate glass, by passing it between embossing rollers, as above described. And, lastly, I claim suspending plates of glass, by their upper edges, after they have been formed, while annealing, so as to keep them in a perfect plane, without resting on a bed."

JUNE 21.

32. For an *Improvement in Cut-off for Steam Engines;* Horatio Allen & D. G. Wells, City of New York.

Claim.—"What we claim is, the mode of operating the loose toes by means of sectors, combined with the rock shaft and operated in the manner substantially as herein described.

33. For an *Improvement in Piano Fortes;* Benjamin E. Colley, Cambridge, Mass.

Claim.—"I do not claim throwing off the fly from beneath the hammer arm by mechanism attached to or connected with the hammer arm itself, as that has been done before; but what I do claim is, throwing the fly of the jack from the arm which operates the hammer each time the note is struck, so as to prevent its "blocking" in the said arm, by the bent lever and set screw, operating independent of the hammer and hammer arm, in the manner set forth."

34. For an *Improvement in Power Printing Presses;* William H. Danforth, Salem, Massachusetts.

Claim.—"I do not wish to limit myself to the precise method of constructing and arranging the parts specified, as these may be varied at pleasure, so long as the principle or character of my invention is retained; what I do claim is, 1st, The employment in one printing press of two parallel type forms, one above the other, and two platens so arranged in a frame, as that a sheet of paper can be printed by each form, at one impression, substantially as above described. 2d, The mode of feeding the paper between the griping bars and bands, which hold it in place to receive the impression, and pass the sheet forward, while the inking roller occupies the intermediate space to ink the type. 3d, Making the feed bands unequal in thickness, as described, for the purpose of furnishing an opening between the two sets, at the time that the sheets are to be entered from the tympan. 4th, The employment of a series of griping or discharging cross bars, in combination with and so arranged upon two endless bands, as to be made to act upon the leading edges of the sheets as they pass along, and hold them against the feed bands, until they have passed across over the top of the pile upon the platform, substantially as shown, for the purpose of piling the printed sheets. 5th, The device for giving and checking the motion of the feed bands alternately as required, consisting of the vibrating lever, bar, reciprocating rack, connecting wheel, feeding wheel, fast wheel or disk, spring pawl, adjustable cam, stud or pin, studs, arm, rocking shaft, cams, pawls, brake, spring, and cylinder, arranged and operated substantially as shown."

35. For an *Improvement in Jacquard Apparatus of Looms;* John A. Elder, Westbrook, Maine.

"The main feature of my invention consists in placing one half of the trap boards directly above the other half, the position being such as to allow the knot-cords to pass from their point of suspension through holes in the two trap boards, thus placed one above the other, and a short distance apart."

Claim.—"What I claim is, 1st, The arrangement of two trap boards, placed the one above the other and between the suspension board and needles. 2d, Two trap boards arranged the one above the other, with their slots in opposite directions to the knot cord holes when combined with the knot cord, having a knot for each board, and a single set of needles for the purpose of vibrating the knot cords from the slots in one board to the slots in the other, the whole arranged and combined in the manner herein set forth."

36 For an *Improvement in Bog Cutting Cultivators;* Edward L. Freeman, Ann Arbor, Michigan.

Claim.—"What I claim is, the precise construction of the tooth, and placed in the position as set forth, that is to say, the vertical part and the horizontal, each having a backward slant."

37. For an *Improvement in Machines for Planing Metal;* Frederic W. Howe, Windsor, Vermont.

Claim.—"What I claim consists in combining with the endless chain and the primary tool carriage, the two slide boxes, (or their mechanical equivalents,) the binders, and rocker lever, and its operative mechanism, (viz: the rod, eccentric, shaft, and lever,) or the mechanical equivalents of such rocker lever, and operative mechanism, the whole being made to operate substantially in manner as described, and for the purpose of enabling a person to readily produce a movement of the tool carriage either to the right or left, while the endless chain has a continuous motion in one direction as set forth."

38. For an *Improvement in Cultivator Ploughs;* William S. Hyde, Townsend, Ohio.

Claim.—"What I claim is, the cultivator herein described, with adjustable supplementary wings, so constructed as to cultivate the soil superficially near the roots of the plants, and deeper at a distance therefrom, the wings being adjustable to any required angle with the bottom of the furrow, so as to give any desired degree of inclination to the sides of the ridges or hills, and to change their inclination from time to time, to adapt them to the varying stages of the growth of the plant, the whole being constructed and operating as described."

39. For an *Improvement in Feed Motion in Plug Cutting Machines;* Simon Ingersoll, City of New York.

Claim.—"What I claim is, the combination, substantially as described, of the slide bar L, having studs or projections, V, *r*, and the slide bar K, having studs or projections, *s*, *r*, the said studs or projections being all so arranged in relation to each other, that the devices which move both slide bars longitudinally, shall first give motion to the slide bar L, for the purpose of forcing the dogs into the board or piece preparatory to the feed, and relieve the dogs therefrom previous to their retrograde motion for commencing a new feed."

40. For an *Improvement in Cutters to Harvesters;* John H. Manny, Waddam's Grove, Illinois; patented in England, December 9, 1852.

Claim.—"What I claim is, a cutter or sickle, composed of a series of lozenge shaped blades attached to a bar, as herein set forth, whereby the pressure of the grass on the front corners of the blades is so counteracted that the latter are not bent down from the edges of the guard fingers, against which they cut."

41. For *an Improvement in Hill Side Ploughs;* David A. B. Newcomb, Conewango, New York.

Claim.—"What I claim is, arranging the two shafts of a double plough, which alternately run forward on a central wheel, in such a manner, that the share which for the time being is in the rear, shall be carried above the bottom of the furrow, substantially as described; also, the method of relieving the swivel, and of steadying and supporting the beam, when set and in turning, by means of a semicircular guide or track, arranged and operating in the manner and for the purposes herein set forth, in connexion with a catch at each end of the track to hold the beam in place when properly adjusted."

42. For an *Improvement in Electro-Magnetic Alarms;* Augustus R. Pope, Somerville, Massachusetts.

Claim.—"For the purpose of ringing the bell, I claim the combination of the movable or vibrating armature, and the spring circuit breaker, with the hammer of the bell, the same to be used in connexion with the electro-magnet circuit wires and a key (as described) applied to a door or window; the whole being made to operate together substantially in the manner and for the purpose as specified."

43. For an *Improvement in Seed Planters;* George Rohr, Charlestown, Virginia.

Claim.—"I claim the invention, use, and application of a ridged, or fluted, or corrugated vibrating apron device, combined with the oscillating screen, or grain scatterer, arranged with a crank handle, axis, actuated by the pins, or cogs, on the scollop-like hub flanch of the propelling wheel, together with the reacting spring rest. The whole arranged and used together with a seed fountain, with apertures so constructed as to admit of connecting thereto short detachable or movable mouth pieces, or outlet spouts, for the more perfect and free escape of the seed from the grain chamber or fountain, on to the apron and scatterer, specifically as set forth."

44. For an *Improvement in Lath Machines;* I. R. Shank, Buffalo, Virginia.

"The nature of my improvement consists in providing the machine with a gauge which is furnished with a vibratory motion, and answers the double purpose of regulating the thickness of the lath, and slipping it from the knife and table in order to be sure of its separation from the board, so as it can be shoved up at every stroke of the machine, and thereby cut a lath."

Claim.—"What I claim is, imparting a vibratory motion to the gauge bar, in the manner described, so that it will not only perform the function of gauge bar to regulate the thickness of the lath, but also that of a slipper, in order to insure the separation of the lath from the block for the purposes described."

45. For an *Improvement in Expanding Mandrels for Turning Machinery;* Walter Sherrod, Providence, Rhode Island.

"The nature of my invention consists in the use of an arbor having a taper turned thereon, on which is fitted an expanding cylindrical shell spring, cut open longitudinally with the arbor, and held in its place by the friction of its elasticity.

Claim.—"What I claim is, a divided spring shell, constructed in the manner described, when it is combined with a tapering mandrel, so that by its own elasticity it shall retain its position on said mandrel, the whole arranged, constructed, and combined in the manner herein set forth. Not meaning to claim the combination of a tapering mandrel with a shell divided into more than one piece and tapering on its interior surface, being held on said mandrel by a spring clasp."

46. For an *Improvement in Horse Collars;* William McK. Thornton, Bloomsburgh, Pennsylvania.

Claim.—"What I claim is, a horse collar formed with pad flaps by the extension of the face leather of the pads as described; also, the manner of stiffening and uniting the pads by means of a metallic bow, the ends of which are rigid to stiffen the shoulder pads and support the tugs, while its arch is flat, thin, and flexible, in one direction, to allow the pads to change their relative distance apart, comparatively rigid in the other direction, to prevent the pads from turning with respect to a plane parallel to the front of the collar."

47. For an *Improvement in Saws;* Joseph H. Tuttle, Seneca, New York.

Claim.—"What I claim is, the combination, arrangement, and location upon the same blade, of the setts of fleam teeth for scoring the sides of the kerf, and the setts of planing teeth for removing the wood between the scores, when said planing teeth are placed back to back; curve in opposite directions, and are between the setts of fleam cutters, and at sufficient distances apart, so that each planing tooth shall serve alternately as a gauge to its fellow, while allowing it to cut to a proper depth, and be a permanent guide to the fleam cutters, to prevent any of the teeth from taking too rank a hold upon the wood, which makes it run with great ease and efficiency, and is applicable to slitting or cross cutting, substantially as described."

48. For an *Improvement in Hill Side Ploughs;* Jonas B. Wilder, Belfast, Maine.

Claim.—"I do not claim a revolving share and mould board, attached permanently to each other; but what I claim is, having the mould board so constructed, arranged, and at-

tached to the share, and land side plate, that said mould board may be turned as set forth, independently of the share, and a proper curved outer face be presented to the sod, on either side of the plough, the mould board being constructed with two faces, precisely of the same form, as herein shown."

49. For an *Improvement in Metallic Pointed Pens;* Benjamin R. Norton, Syracuse, New York.

Claim.—"What I claim is, a metallic pointed pen attached to a wire of the length required to form a handle or holder, when such pen and holder are covered from the top of the holder to near the nib of the pen by a coating of gutta percha or india rubber, of suitable thickness, made in the manner and for the purpose set forth."

50. For an *Improvement in Propellers for Canal Navigation;* William F. Tyson, Orwigsburgh, Pennsylvania; ante-dated December 21, 1852.

Claim.—"What I claim is, the blades constructed with lips or rims, which are sections of a cylinder concentric with the axis on which the propeller rotates, as herein specified."

51. For an *Improvement in Side Lights for Ships;* Enoch Hidden, City of New York.

Claim.—"I do not claim ship lights turning on pivots or centre pins in frames; nor do I claim ship lights in frames turning on hinges; but what I do claim is, the arrangement of screws tapped into the main frame, in combination with inclined planes, or spirals forming part of said screws that holds the light frame, or cell containing the glass, fast to the india rubber in its grooved seat, in the main frame, with its stop pin for stopping the screw in its proper position, when the light is to be opened for ventilation; also, the projecting ears, with slots or chase mortises, in which the pivots of the light frame or cell turns, allowing the light to be hauled from its seat, and consequently out of contact with the india rubber, so as to allow the plane of the light to be placed at any angle to the main frame, thus freely admitting of ventilation. And further, I claim the arrangement of a lead or other ductile metallic ring, soldered on, or otherwise joined to the main brass frame of the light, so that it can be turned round the other edge of the opening in the vessel, securing any suitable material, completely, making the main frame of the light water tight to the vessel; the whole substantially as herein set forth in this specification and drawings, forming part of the same."

52. For *Improvements in Envelope Folding Machines;* R. L. Hawes, Worcester, Mass.

"The nature of my invention consists in providing in one self feeding machine, the ability, when motion is given it, to take one sheet of paper at one time, and carry it forward to impress or form a base, and thus to retain it until it is carried onward to the finisher, whence it is discharged, a finished or folded and pasted envelope. The paste being applied in its process, as will be hereinafter fully described."

Claim.—"What I claim is, 1st, The combination of the self adjusting feed table, with the paste fountains, so arranged as that they will descend, and press a freshly pasted surface of their rollers upon the top sheet, and raise it to permit the table to pass beneath and take away a sheet at every second revolution of the main shaft. 2d, The combination of the platform with the hooks, and the retaining fingers, and the fingers for discharging, for the purpose of properly conveying and discharging the sheet or envelope. 3d, The combination of the platform with the follower or first presser and its weight or retainer, as described. 4th, The finishing holder, consisting of knives, with their adjustable spring and guides, in combination with the finishing plunger, to press the envelope and cause the three flaps to adhere together or one to the other. 5th, The arrangement for raising the table, in combination with the fingers, for discharging the finished envelope; all of which is herein before fully described and set forth."

JUNE 28.

53. For an *Improvement in Refrigerators for Cooling Liquids;* Barnabas H. Bartol, Philadelphia, Pennsylvania; patented in Cuba, October 8, 1852.

Claim.—"I do not desire to claim the application of the current of air of a fan blower to cool water; but what I do claim is, the arrangement of the series of partitions and interstices, for cooling water, in the manner and for the purpose, substantially as herein set forth."

54. For an *Improvement in Bobbins;* Horatio Clarke, Dedham, Massachusetts.

Claim.—"I do not claim the making a bobbin head of two layers or disks of wood,

glued or cemented together; nor do I claim the invention of constructing one of raw hide entirely; but what I do claim is, the making the bobbin head as described, viz: of a combination of wood and raw hide, or other material having like properties, whereby the head is not only cheaply constructed, but rendered properly stiff, and capable of resisting the effects of blows, falls, or wear, as above stated."

55. For an *Improvement in Shuttle Box Motion in Looms;* Christopher Duckworth, Thompsonville, Connecticut.

"My improvement consists in the manner of operating the shuttle boxes, by means of the levers, friction rollers, notched sides, &c., so that the shuttle boxes may receive a lateral, vertical, and diagonal motion at pleasure; and may also be kept in any one position, as long as is required for any figure or character of the fabric, and be changed backward and forward, at pleasure, being governed by the card pattern."

Claim.—"What I claim is, the method of giving a three-fold movement (lateral, vertical, and diagonal,) to the shuttle boxes as described, by which I am able to operate any required shuttle at any given pick; I also claim the apparatus for operating the shuttle boxes, consisting of the case, with its friction rollers and slides combined with the levers, which work the slides, and the principal lever, which moves the shuttle boxes, when the whole is constructed, arranged, and combined substantially as herein described."

56. For an *Improvement in Melodeons;* Horatio N. Goodman, New Haven, Conn.

Claim.—"I am aware that two sets of keys have long been used in organs, and that two sets of reeds have been used in reed instruments; I therefore do not claim either of these, as such, as my invention; but what I claim is, the combination of the two sets of reeds with the two sets of keys, when these are combined with the two sets of valves, and so arranged, that each set of keys may play their own set of reeds independently, or so that the lower set of keys may play both sets of reeds, (in the ordinary way of two stops,) while the upper set of keys may play its own set of reeds only, in any other part of the key board, at the pleasure of the performer, when constructed and combined substantially as herein described; I also claim the within described method of coupling or connecting the lower set of keys, with the back set of valves, so that both sets of reeds may be played by the lower sets of keys, when the several parts are constructed, arranged, and used, in the manner and for the purposes substantially as herein described."

57. For an *Improvement in Machines for Twisting Waxed Ends;* Daniel H. Hovey, Kilborn, Ohio.

Claim.—"What I claim is, the combination of the revolving rollers or tubes, conical coupling cores, the spring tighteners with the detaching levers, arranged and operated substantially in the manner and for the purpose herein described."

58. For an *Improvement in Coating Zinc with Lead;* Edmund Morewood and George Rogers, London, England; patented in England, December 12, 1850.

Claim.—"We are aware that metals have been coated, one with another, by washing and plating, to protect them from oxydizing agents, &c., but we are not aware that zinc and lead have ever been united, and rolled into united laminæ of each of these metals, as above described. Therefore, we claim such a composite sheet as a new and useful manufacture, or article of merchandise or trade, of great value and importance, and which possesses the hardness, stiffness, and strength of zinc, with the capacity of lead, to resist the action of oxydizing agents, as herein set forth."

59. For an *Improvement in Bran Dusters;* Levi S. Reynolds, Indianapolis, Indiana.

Claim.—"What I claim is, the employment of the conical roughened metallic scourer in combination with the double disk rubber, the disks and pins of which always preserve the same relative positions; being arranged and operated in the manner and for the purpose set forth."

60. For an *Improvement in Percussion Pellets;* Christian Sharps, Hartford, Connecticut; patented in England, April 22, 1852.

Claim.—"What I claim is, the percussion pellet herein described, consisting of a quantity of detonating material, enclosed between two flanched disks, or shallow hollow cylinders, closed at one end; the open end of one cylinder being fitted into the open end of the other, and the two being firmly interlocked, by crimping together their flanches, rims, or peripheries, substantially as described, so as to form a pellet in the form of a disk."

61. For an *Improvement in Tuning Melodeons, and other Reed Instruments;* Edmund E. Shepardson and Edwin Lucas, New Bedford, Massachusetts.

Claim.—"We do not claim inserting reeds in pipes or tubes, for that has been previously done; but what we claim is, securing or attaching the reed to a movable pipe or tube, the reed being arranged or placed between stationary clamps, by which, as the pipe or tube is moved, the vibrating portion of the reed may be lengthened or shortened, and the desired tone obtained, as herein shown and described."

62. For an *Improvement in Machines for Turning Irregular Forms;* Lauren Ward, Administrator of Richard Ward, deceased, Naugatuc, Connecticut.

"The improvement consists in the use of the jointed levers, suspended from a bar or frame above the crank, by which the levers are operated, to elevate and depress the front end of the inner part of the carriage to the desired extent, for planing the article in an elliptic shape of polygon; and in the use of the notched collet on the front or toothed centre, connected with the ratchet wheel, which, by means of the curved bar, raises the front end of the inner part of the carriage still higher and more suddenly, than the operation of the levers would do, at the proper time, to give form to a more prominent part of the article, as the square part of a spoke."

Claim.—"What I claim is, the combination of the jointed levers, suspended by their upper ends with the crank and connecting rod, when so constructed and arranged as to elevate or depress the inner part of the carriage, and the toothed centre, in such a manner as to give a regular elliptical form to the polygon, where the opposite longitudinal sections will be equal and similar, when the whole is constructed, arranged, and combined, substantially as herein described. I also claim the use of the notched collet, on the toothed cutter, and the curved bar, in combination with the jointed levers, to give regular and irregular forms to different parts of the same elliptic polygon, when the whole is constructed and combined substantially as herein described."

63. For an *Improvement in Metallic Boxes for Presses, &c.;* James Foster, Jr., and Platt Evans, Jr., Cincinnati, Ohio.

Claim.—"What we claim is, the mode of preventing the shrinking and binding of metal bushings, when cast upon screws, mandrels, spindles, shafts, and the like, by the insertion of feathers, either movable or fixed in the boxes to be bushed, for the purpose of separating or breaking the ring of bushing metal, substantially in the manner and for the purpose herein set forth."

64. For an *Improvement in Presses;* Amzi C. Semple, Assignor to William C. Semple, Cincinnati, Ohio.

Claim.—"What I claim is, sustaining the gear frame of a double toggle press, by the toggle arms and joints, independent of and disconnected from the frame of the press, by attaching the same firmly to the nut, as described, in combination with supporting the screw by the nuts thus sustained only; the whole being arranged substantially as described."

65. For an *Improvement in Threshers and Separators of Grain;* Napoleon B. Lucas, Otter Creek, Illinois.

Claim.—"What I claim is, the auxiliary screen, placed in an auxiliary position, or nearly so, and projecting from the rear end of the inclined screen, so as to be out of the axis of the blast over the said screen, for the purpose of catching and saving the blighted and lighter kernels of grain, which may be blown beyond the rear extremity of the said inclined screen, substantially as herein set forth."

Re-issues for June, 1853.

1. For an *Improvement in Cooking Ranges;* Moses Pond, Boston, Massachusetts; patented February 25, 1851; re-issued June 7, 1853.

Claim.—"What I claim is, the improvements by which the hot water back is connected with the plate, e, and by means of which said hot water back may be either readily removed at any time, or applied in such manner that the directions of its water pipes may be disposed so as to accommodate the bath boiler, into which they are usually led, on whatever side of the range the bath boiler may be placed; the said improvements consisting, 1st, in the connecting piece, H, and the attachments of it, and the hot water back; the whole being made to operate together substantially in the manner as above set forth. 2d,

in a second set of attachments, (fixed on the opposite face of the water back,) in combination with the first set thereof, as described. I also claim the peculiar arrangement of flues, which lead the smoke and volatile products of combustion directly around the oven, the said arrangement of flues causing the heat to course against a portion or one-half of the bottom of the oven; next, into another flue, which takes it backwards, and against the other portion or half of the bottom of the oven; thence, up a flue against the oven; thence, through a flue, extending over and against a portion or half of the top of the oven; thence, into and through another flue, which carries it backwards and over and against the top of the oven, and conveys it to the chimney or discharge flue; not meaning to include in such arrangement the radiating chamber or space, Y Z, herein before mentioned. And I also claim the two recesses, *l m*, and two flue plates, *p q*, applied to the plate, K, in combination with the two valve openings, X A′, their damper and cover plate, as applied to the top plate of the oven frame, and used under an arrangement of oven flues, substantially as described, the same allowing of the adaptation of the oven to either side of the fire place, or the use of two such ovens and their frames, in connexion with the fire place, all essentially as herein before stated. I also claim the improvement by which the oven can be raised and readily removed, and by which the smoke is prevented from passing underneath the partition which separates the flues on top of the oven, the same consisting in the sliding or gravitating plate, G′, affixed to the partition, and made to operate substantially in the manner as specified."

2. For an *Improved Lubricating Compound;* Patrick S. Devlan, Reading, Pennsylvania; patented January 16, 1849; re-issued June 14, 1853.

"The nature of my invention consists in combining with animal or vegetable oil, or other fatty matter, such as concrete fats, a solution of caoutchouc or other similar gum, dissolved in turpentine or other solvent."

Claim.—"What I claim is, the combination of a solution of caoutchouc or other similar gum, with animal or vegetable oil or fatty matter, substantially as specified, applicable as a substitute for oil, in lubricating machinery, and for other purposes."

3. For an *Improvement in Apparatus for operating Shuttle Boxes of Looms;* James A. Bowie and Charles Carr, Assignees of Robert B. Goodyear, Philadelphia, Pennsylvania; patented March 13, 1849; ante-dated Sept. 13, 1848; re-issued June 14, 1853.

Claim.—"Having fully described the method of raising the shuttle boxes of power looms having two or more shuttles, what is claimed therein as the invention of the said Robert Burns Goodyear is, the employment, for the purpose of weaving, of an index plate, having movable and adjustable pins, projecting at different distances from the face of said plate, in combination with the shoe, or its equivalent, having projections corresponding to the different length of pins, for the purpose of raising and falling the shuttle boxes, to correspond with the pattern desired to be formed; the whole constructed and arranged in the manner herein described."

4. For an *Improvement in Machinery for making Mouldings;* Alfred T. Serrell, City of New York; patented May 16, 1848; re-issued Jan. 7, 1851; re-issued June 21, 1853

Claim.—"What I claim is, 1st, The combination of the ring or rings with a cutter or cutters, for operating on an angular strip for making a moulding, whether the said cutter or cutters be rotating or stationary, or both, and whether the said cutter or cutters operate on the face or on the edge of the strip, or on both the face and the edge, substantially as herein described. 2d, The combination of the adjustable bed with the ring or rings and a cutter or cutters, as aforesaid, for operating on an angular strip for making a moulding, whether the cutter or cutters be rotating or stationary, or both, and whether the said cutter or cutters operate on the face or on the edge of the strip, or on both the face and the edge, substantially as described."

5. For an *Improvement in Gas Regulators;* Walter Kidder, City of New York; patented October 12, 1852; re-issued June 28, 1853.

Claim.—"What I claim is, balancing the varying pressure of the gas in the main, by connecting with the valve a disk, which receives pressure from the main, to balance the pressure on the valve, substantially as described, or the equivalent therefor, in combination with the method, substantially as described, of governing the aperture through which the gas passes to the branch, of the varying pressure of the gas, beyond the valve which governs the aperture, as described, so that when the pressure becomes too great, the aperture shall be reduced, and vice versa. And I also claim, in combination with the above, making the disk so that it shall be also acted upon by the varying pressure in the branch to assist

in moving the valve to govern the aperture for the passage of the gas, substantially as specified, whereby the action of the instrument is rendered more sensitive and prompt as a governor."

DESIGNS FOR JUNE, 1853.

1. For a *Cook Stove;* John T. Davy, Troy, New York, June 21.

Claim.—"The ornamental design and configuration of jamb plate, for a cook stove, such as described."

2. For a *Cooking Stove;* John Sabey, Jr., Rochester, New York, Assignor to James K. Griffin, Waterdown, Canada West, June 21.

Claim.—"The ornamental design of a stove plate, substantially as described and represented."

3. For a *Cook Stove;* Everard Bolton, Northern Liberties, Assignor to Abram and Jos. Cox, Philadelphia, Pennsylvania, June 21.

Claim.—"The ornamental designs in bas-relief upon the doors and plates of the configuration and arrangement set forth, forming a new and original design for the cook stove, called the Triumph Complete."

4. For a *Cook Stove;* N. S. Vedder, Troy, New York, June 28.

Claim.—"The ornamental design and configuration of cook stove plates, such as described and represented."

5. For a *Cooking Stove;* Samuel D. Vose, Albany, New York, June 28, 1853; antedated May 2, 1853.

6. For a *Cooking Stove;* Samuel D. Vose, Albany, New York, June 28, 1853; antedated May 2, 1853.

7. For a *Cooking Stove;* Samuel D. Vose, Albany, New York, June 28, 1853; antedated May 2, 1853.

8. For a *Parlor Stove;* Samuel D. Vose, Albany, New York; June 28, 1853; antedated May, 2, 1853.

The claim, in each of the above four patents, is, the combination of mouldings and ornaments, as arranged in the cooking stoves, A, B, C, and parlor stove, E; the whole, in each, forming an ornamental design.

9. For a *Register Face;* James Cowles, Assignor to Albert G. Bristol, Rochester, New York, June 28.

Claim.—"The new and original design for a register face, formed by the peculiar arrangement of the metallic bars, as shown in the accompanying drawing."

JULY 5, 1853.

1. For an *Improvement in Instruments for Connecting Lateral Deviations of the Spine*, Alanson Abbé, Boston, Massachusetts.

Claim.—"I claim the above described instrument, as made of a combination of the crutch, A, the hip plates, C, the plates E, I, the wedges and screws thereof, the breast or body band, L, and its pads and straps, or other contrivances for confining the whole instrument to the thigh and body, the whole being applied together and made to operate substantially in manner and for the purpose as specified."

2. For an *Improvement in Brushes;* J. Cross, New London, Ohio.

Claim.—"What I claim is, a brush consisting of a divided case to hold the handle and bristles, constructed and arranged as described, in combination with a wedge forced among the ends of the bristles within the case, and tightened from time to time, so as to squeeze and hold them, by screwing the two parts of the case together, substantially as specified."

3. For an *Improvement in Clavicle Adjusters;* A. M. Day, Bennington, Vermont.

Claim.—"I do not of itself claim a yoke to fit the neck; but what I do claim is, the arms of the yoke hollowed as described, in combination with the straps, attached and operating as described, by means of which the acromion process of the scapula is com-

pressed, and the arm held in position, for uniting a fracture of the clavicle, substantially as specified."

4. For an *Improvement in Cradle and Tete-a-tete;* George H. Hazlewood, Boston, Massachusetts.

Claim.—"What I claim is, to construct the two sides of the bed frame of the cradle, that portions of each may be turned around and arranged parallel to one another and across the bed frame, so as to convert such bed frame into a "tete-a-tete" seat or chair, substantially as specified."

5. For an *Improvement in the Manufacture of Cannon and other Fire Arms;* Chas. W. Lancaster, New Bond Street, England; patented in England, January 16, 1851.

"My improvement consists in a peculiarly shaped bore to the gun, whereby the angular groove usually cut in such arms, more particularly in rifles, is dispensed with, while the advantageous effects of such grooves are yet retained. This peculiarity of boring I also apply to cannon, as will more fully appear in the following description."

Claim.—"Is, 1st, The method of boring the barrel of a gun, or other fire arm, so that a cross section thereof would be in the form either of an ellipse or of a series of curves by the mechanism as described, or its substantial equivalent, as set forth, whereby the injurious action of the angular groove in ordinary rifles is obviated, while all its advantages are retained. 2d, The construction of the boring tool for giving to the bore a form, of which the cross section is not a true circle, that is to say, I claim the combination of the cutter-bar with the boring-tube, the said bar passing through said tube eccentrically, the axes of both being parallel, whereby the elliptical or other shaped bore is given as described; also the bar, *u*, and its inclined plane in combination with the cutter, for regulating the depth of the cut as described; also, the expanding collar, the inclined or beveled space on the boring-tube, with the other parts in connexion therewith, as described, for the purpose of guiding the boring-tool when boring out an irregularly formed cylinder, as described. 3d, The curved rail, or other like fixture, for giving the proper motion to the barrel of the gun during the boring operation, by which the spiral or twist is given as described. 4th, The cap for supporting the boring-tube, just at the moment the cutter is about to clear the muzzle, as set forth."

6. For an *Improvement in Propelling Vessels;* Thomas L. Mitchell, Birkenhead, England; patented in England, November 25, 1848.

"The invention consists of applying an instrument, in the nature of a "Bommareng," placed in a suitable axis, as a propeller for propelling vessels."

Claim.—"Is constructing the blade or blades of the same upon the principle or in the form of the "Bommareng," as described and represented."

7. For an *Improvement in Trusses;* John North, Middletown, Connecticut.

Claim.—"Is the mode herein set forth of adjusting the pressure of the pad, that is to say, by the employment of the right and left screw, and the adjusting nut, in combination with the pad lever, in the manner and for the purpose set forth."

8. For an *Improvement in Lanterns;* William Porter and Edward A. Tuttle, Williamsburgh, New York.

Claim—"Is the small rods, extending from the lower part or cup of the lantern, to the top or cap, and uniting them both together by a catch, thereby securing the globe between them in the manner substantially as described, for the purpose set forth."

9. For an *Improvement in Paddles for Vessels;* Amzi C. Semple, Cincinnati, Ohio.

Claim.—"Is the use of vulcanized india rubber, or other similarly elastic substances, which will produce the intended effect in the construction of floats of paddle wheels, for the purpose and in the manner described."

10. For an *Improvement in Crow Killers;* Noah J. Tilghman, Salisbury, Maryland.

Claim.—"Is the combination of the dart, helical spring, sliding rest or head, attached to the trigger, the trigger, and the dog, with the hollow post, in which it is placed."

JULY 12.

11. For an *Improvement in Pressure Gauges;* Edward H. Ashcroft, Boston, Mass.

Claim.—"What I claim is, the method herein described, of rendering the indications of bent-tube pressure gauges, permanent and reliable, by constructing said tubes of precious metal, as set forth."

12. For an *Improvement in Shot Chargers;* Chauncey W. Camp, Hartford, Conn.

Claim.—"What I claim is, the manner and method of making, and the application of the revolving cut-off and spring, to shot chargers, substantially in the manner and for the purpose as set forth."

13. For an *Improvement in Butter Workers;* E. J. Dickey, Hopervell Cotton Works, Pennsylvania.

Claim.—"What I claim is, the adjustable knives, arranged within the box of said machine, and operating in conjunction with the reciprocating presser, substantially in the manner and for the purpose set forth. I also claim the recess or depression, in the bottom of the box, for the purpose of preventing the butter's adhering to the presser, and being drawn back during its receding motion, substantially as described."

14 For an *Improved Apparatus for Illustrating the Motion of a Pendulum upon the Earth's Surface;* George M. Dimmock, Springfield, Massachusetts.

Claim.—"What I claim is, 1st, The application to an artificial globe, of one or more pendulums, the rods of which are formed of delicate springs, so as to vibrate evenly to all points of the dial, the plane of which is at right angles to the pendulum when at rest. 2d, I claim the bending or springing the pendulum rods, to counteract the gravity of the earth, so that when at rest they will be straight, and on the line from the point of suspension and the centre of the globe; furthermore, I claim anything substantially the same. I do not claim a ball suspended or strung on a string, or thread, and applied to an artificial globe, or applied in any manner whatever, to illustrate the rotation of the earth, by the vibration of a pendulum."

15. For an *Improvement in Tanning;* John J. Fulton, Allegheny City, Pennsylvania.

Claim.—"What I claim is, the use of muriate of ammonia in combination with nitre for the purpose of suspending putrefaction, adding strength to the animal tissues, and for usual purposes in the manufacture of leather, as set forth."

16. For an *Improvement in Hose Coupling;* Smith Groom, Troy, New York.

Claim.—"What I claim is, the spring conduit, and the appendages by which it is moved longitudinally, and is held firmly against the packing and the pads or rim in which the packing rests, to prevent the joint from leaking, in combination with the arrangement of spring bolts and their appendages, with the circular groove, for the purpose set forth."

17. For an *Improvement in Sheet Metal Beams;* Richard Montgomery, Assignor to Elizabeth Montgomery, City of New York; patented in England, October 13, 1852.

Claim.—"I am aware that plates of metal, for roofing and steam boilers, have been bent into every form by a process commonly termed corrugation for the purpose of stiffening them; but in every such case, the series of folds are comparatively shallow, and instead of the strips between the arches being parallel and in the plane of pressure, they are inclined to each other, and stand obliquely across the plane of pressure, in which position they would break down with a load that they could easily support if placed vertical and parallel as in my beam. And to a plate with such inclined strips, I therefore make no claim, as it is not suitable for a beam. But I do claim a beam formed of sheet metal, bent into a series of longitudinal folds, the sides of which are flat and parallel, and the tops and bottoms uninverted and inverted arches respectively. I also claim the combination with such a beam, of a pair of saddles to support its ends, substantially as set forth."

18. For an *Improvement in Metallic Pens;* Myer Phineas, City of New York.

Claim.—"I am aware that Perry attempted to give the proper degree of flexibility to pens, by making a transverse slot in the back, and extending it along the side of the pen, leaving a narrow spring beneath, inclined equally to the side and back of the pen, which renders it too rigid for the easy working of the pen, unless made so long that its great range of flexure renders it difficult to direct. I therefore make no claim to a side and back slot, or to a spring inclined equally to the back and side of the pen. But what I do claim is, constructing the back of the pen with a series of transverse ribs and slots, and leaving two flat springs beneath, nearly parallel to the back, and free to bend between the ribs; the effect of this construction being to give to the pen, combined stiffness and flexibility within certain limits, resembling that produced by a series of vertebral articulations, and which is formed to render the working of the pen more easy and pleasant, than any form of metallic pens heretofore essayed."

19. For an *Improvement in Coin Safe and Detector;* Henry G. Robinson, Schuylkill Haven, Pennsylvania.

Claim.—"I do not claim detecting counterfeit coin by means of a gauge and scales, for that is well known. But what I claim as new is, the peculiar construction of the implement and the manner in which the several parts are arranged; by which construction and arrangement, I combine a portable receptacle, for both coin and bank notes, convenient for the pocket, and a counterfeit coin detector. The implement being formed of a cylindrical case, having a gauge box or receptacle at one end, and the remaining portion of the case enclosing the clamps, for the purpose as shown, and otherwise constructed and arranged substantially as set forth."

20. For an *Improvement in Boring Machines;* Samuel T. Sanford, Fall River, Mass.

Claim.—"What I claim is, fitting the auger stock, by a ball and socket, or other universal joint, to an arm, which is connected with a fixed base or standard, so as to be capable of moving in arcs at any angle to each other; and giving rotary motion to the auger so arranged, by means of a pulley attached to the auger, and a band receiving motion from a pulley on a shaft, at the butt end of the pole or arm, substantially as described."

21. For an *Improvement in Adjusting Dishing Saws;* Ephraim B. Wells, Uniontown, Pennsylvania.

Claim.—"What I claim is, the adjustable rings, in combination with the concave and convex washers, as described, for the purpose of holding and regulating the saw to any required curvature."

22. For an *Improvement in Straw Cutters;* Ithamar P. Smith, Rochester, and Oran W. Seely, Albany, Assignors to Oran W. Seely, Albany, New York.

Claim.—"We claim the arrangement of the metallic guide, in combination with the knife frame and the knife formed as specified, and with the frame against whose front edge the knife is intended to play; the said last mentioned frame to be adjusted to its place by springs and screws, contained in the hollow boxes or cars, and by trunnions and shoulders, substantially in the manner set forth."

23. For an *Improvement in forming Teeth on Mill Saws;* Nathan T. Coffin, Knightstown, Indiana.

Claim.—"I do not claim the form of the chisel tooth, as teeth hooked or projecting have been made before, though not precisely of the same form as mine; neither do I claim separately the instruments for dressing and keeping the saw in order. But what I do claim is, the dies, E and C, and gauge, constructed as described, by means of which uniform chisel points are given to saw teeth by swedging, substantially in the manner and for the purpose specified. Also, the combination of the files, *r* and *g*, the block, tinned surface, and regulating screw, forming together the file gauge, by means of which, when used in combination with the beveled file, the chisel pointed saw teeth herein described are dressed, jointed, and have their edges rendered uniform, substantially in the manner specified."

24. For an *Improvement in Adjustable Screw Propellers;* Charles F. Brown, Warren, Rhode Island.

Claim.—"I am aware that others have tried to effect the same object by placing the blades one behind the other; but this arrangement renders it necessary to cut much more of the after part of the vessel, and weaken it unnecessarily and to a very dangerous extent, as is the case in the arrangement shown in the London "Mechanics' Magazine," vol. XL. p. 241. What I claim is, 1st, Arranging the pivots of the adjustable blades out of the centre of the hub, or at a distance from the axis, and carrying them right through the hub, substantially as described, whereby they obtain a greater depth of bearing, without placing one blade behind the other, and thereby rendering it necessary to cut away the after part of the vessel unnecessarily; this I claim without reference to precise means by which I turn the said pivots to adjust the blades. 2d, The employment of one of the adjustable blades of the screw propeller as a rudder in case of need, when the said blade is operated for this purpose by mechanism substantially as is described, which also serves to adjust the blades as a propeller."

25. For an *Improvement in Locks for Banks;* Linus Yale, Jr., Newport, New York.

Claim.—"What I claim is, 1st, Impressing the form of the key upon inert tumblers, or their equivalents, which shall retain said impression while being separated from the key,

and beyond reach or influence through the key-hole before they can touch the fence, for the purpose and in the manner substantially as described. 2d, I claim, in combination with inert tumblers, the cross bolt, which takes the strain of end pressure on the main bolt, and acting as a tumbler carriage, to convey the tumblers beyond reach or influence through the key-hole, when it moves them to the fence out of its locked position with the main bolt."

26. For an *Improvement in Railroad Car Seats,* Charles P. Bailey, Muskingum, Ohio, Assignor to Union Patent Sofa and Railroad Car Seat Manufacturing Company, City of New York.

Claim.—"What I claim is, so hanging a reversible car seat, whose seat when reversed forms a portion of the back, and vice versa, as that it shall occupy the same space after it is reversed that it did before, or hang between, or nearly so, the same parallel lines that it did before reversing, and so that also the seat and back may have an adjustment together, or independent of each other, substantially as described; and this I claim whether the seat is divided into two or more parts, or used without division, as herein set forth."

MECHANICS, PHYSICS, AND CHEMISTRY.

On Iron, and some Improvements in its Manufacture. By Mr. J. D. Morries Stirling.*

(Continued from page 41.)

Before proceeding to touch on certain other processes, which the writer believes to improve iron for special purposes, it may be well to point to some alloys of cast iron, as the making these led him to make the addition of the same and other metals to wrought iron.

The first is an alloy of iron and tin, which is extremely hard, sonorous, and capable of receiving a very high polish; the addition of manganese, and a very small per centage of zinc, gives somewhat greater tenacity. Bells made of these alloys have a pure and clear tone. Cast iron will take up from 20 to 25 per cent. of tin.

Cast iron, alloyed with zinc, becomes closer in its texture, and, as far as the writer's experiments have yet gone, stronger, and not less malleable. Alloys of bismuth, antimony, copper, and silver, possess some scientific interest, but it would be out of place to touch on them now.

Having observed the hardening effect which tin produces upon cast iron, the writer tried a similar mixture in the puddling furnace, and found a corresponding result, with this essential difference—that whereas cast iron will take up about a fifth of its weight, wrought iron is rendered too hard for subsequent working by any quantity exceeding one per cent.; and, taking the various descriptions of iron (Staffordshire, Scotch, and Welsh), one-half per cent. of tin produces a description of iron crystalline, close in texture, and harder than common wrought iron.

This quality of iron appeared to be suitable for the wearing surfaces of rails and tires of wheels, and subsequent trials which have been made have fully confirmed this opinion. Lamination is prevented, and the rail, when properly made, wears smoothly and evenly. As in all iron, and particularly in rails, much depends on manufacture; but points and crossings made of this hardened iron, and rails upon sharp inclines, where the wear previously had been very rapid, have been found to last more than

* From the London Artizan for April, 1853.

double the time of any rails previously tried, and, as they are yet not worn out, it is at present impossible to say how much longer they will last. The writer does not believe their increased duration to arise solely from the *greater hardness*, but more from the peculiar crystalline texture and fine grain of the iron resisting the lamination, which great speeds and heavy engines so rapidly produce. The sections of the rails show the proportion which it is considered best that the crystalline should bear to the fibrous iron, or to whatever other iron the rail may be composed of.

The addition of zinc, its oxides and other ores, produce the very opposite effect to tin and the other metals above named. Iron of what is called cold-short quality is rendered, by this means, fibrous, tough, and strong; red-short iron is also improved in quality by the same means, but it is found that a larger addition of zinc or its ores or oxides is required to effect an improvement in red-short than in cold-short iron. The quantity necessary to improve cold-short iron varies much in different districts, and each peculiar iron requires to be separately considered; it is also necessary to know the per centage of zinc in the ore, if ore be employed, and to ascertain that such ore does not contain foreign matters, which might counteract the effect of the zinc. The addition of these metals to the iron is best made when the iron in the puddling furnace is beginning to boil.

The writer was much gratified to observe in the American department of the Great Exhibition a confirmation of his experiments on this subject; iron, naturally cold-short and red-short, being rendered free from each of these qualities by the addition of an ore of zinc. Samples in all stages of progress were exhibited.

Table of Comparative Strength of Wrought Iron.

Description of Iron.	Tensile Breaking Strain.	Deflection. with Strain of 9½ cwt.	Permanent Set, in Lengths of 2¼ feet.	Final Stretch, in Length of 2 feet.
	Tons per in.	Inches.	Inches.	Inches.
Hardened wrought iron, with ¾ per cent. tin,	22·92	1·42	1·02	¼
Toughened wrought iron,	27·81	—	—	—
Dundyvan best bar . .	24·33	2·02	1·60	3½
S. C. Crown average result	24·47	—	—	—
Hartley's general average of bar iron . .	23·33	—	—	—

Had the limits of a mere sketch like this permitted, the writer would have entered on the consideration of the relative qualities of cold and hot blast iron, and of the effects produced by the use of cinder; also, on some combinations of iron with the earthy bases, and on the effects of various salts and fluxes in the blast and other furnaces Several other alloys of iron possess considerable interest, and, in conclusion, allusion may be made to a remarkable property which iron possesses of closing the grain of other metals and alloys to which it is added in minute quantity.

Mr. Stirling exhibited a number of specimens of the toughened wrought

iron in bars, and the hardened wrought iron, as applied to the surface of rails, showing their fractures; and specimens of the toughened cast iron, showing the mode of mixing the wrought-iron scrap with the pig metal; also specimens of an alloy of zinc, copper, and tin, and another of the same composition, with an addition of 1⅓ per cent. of iron, showing the great closeness and fineness of grain that were produced by this small admixture of iron. It was explained that it was advisable to alloy the iron with the zinc before mixing with the copper, otherwise, there would be imperfection and unsoundness in the metal, the iron appearing in the form of what are technically called "tears."

The Chairman said he considered it a very important subject, and thought the paper showed valuable results of extensive practical trials combined with scientific inquiry. He asked at what period the tin or zinc was added to the wrought iron.

Mr. Stirling replied, that it was put into the puddling furnace when the extreme of the boiling was just passed, or passing, and conversion just commencing, and the formation of spicula beginning. A more fluid iron required the metal to be put in at a later period, and iron that came to mature sooner required the metal put in earlier. It was difficult to give a definite rule, it could only be judged of by particular experience.

Mr. Duclos thought the presence of zinc in the iron was doubtful; from its volatility, the greater proportion would probably be dissipated in the furnace. He considered it more probable that the change in the iron was caused by the physical quality of the iron undergoing some alteration in consequence of the presence of the zinc.

Mr. Stirling said he did not consider the mixture of zinc with the iron to be in all cases an alloy, as the proportion was occasionally only ¼ per cent., and he felt uncertain about its mode of action; the quantity of zinc required varied very much; it had to be determined by experiment with the different ores and furnaces.

Mr. Duclos observed that, in some iron works he had been acquainted with in Belgium, he had never found any trace of zinc in the iron made from ore containing zinc, but metallic zinc was found to accumulate in the top of the furnace. Many years since a series of experiments had been made by M. Carsen on various mixtures of iron with zinc and other metals, but they had not led to any practical application. There was no question that sufficient attention had not been paid to the properties of the alloys that can be made with iron, and he was glad to see the steps taken by Mr. Stirling; he did not quite agree as to the want of knowledge of the iron manufacture, he thought there was a great deal of knowledge on the subject, but he would wish the principles carried out further.

Mr. Stirling remarked that, in the case mentioned, in Belgium, two processes—smelting and refining—intervened, by which most, if not all the zinc might be volatilized. There was no doubt that the practical making of iron was well understood, but not the theory and principles, otherwise the process might be further simplified, and, as the result, iron would most probably be produced complete at one process, instead of two or more. He thought that further improvements would be more studied and accomplished when iron and coal were dearer.

Mr. M'Connell said there was great room for improvement in railway tires and rails. If the tire now lasted 70,000 miles on the driving wheel of an engine, it was considered very good work. The expense of replacing tires, and of failure, was a very serious item; and if, by Mr. Stirling's process, the iron could be made to last longer, it would be a great source of economy and convenience.

Mr. Beasley inquired why the wrought-iron scrap was put into the pig mould, in making the toughened cast iron?

Mr. Stirling replied, that one object was to insure a definite proportion for each charge; also, the wrought iron melted more easily in the furnace, when mixed in that manner with the cast iron, which seemed to act as a flux, the whole getting heated together; the cast iron dropping, eats away the wrought iron. If thrown separately into the cupola, part of the cast iron would melt down first, and the two would not get uniformly mixed; the wrought iron was liable to get oxydized, and wasted.

Mr. Beasley observed, that he was aware if the wrought iron was thrown into the puddling furnace with the pig, it would burn away and not improve the quality; but if it was thrown into the fire a little time before the puddler commenced balling his iron, it would very much improve the quality.

Mr. Stirling said that it was an old practice to add wrought iron in the puddling furnace, in order to get a quicker yield; but it would not melt thoroughly in that case, and make a uniform mixture. It should be first remelted in the cupola from the mixed pig, to make a uniform mixture, and then remelted, and worked in a puddling furnace.

Mr. Beasley remarked, that he had melted wrought iron in the cupola, and then worked it in the puddling furnace, and he had found the result to be better than from the ordinary pig iron alone; but it was not a sufficient advantage to make it worth the extra expense; he had obtained a greater yield.

Mr. Stirling observed there was a process for melting wrought iron, which was then converted back, by decarbonizing, to a state approaching to steel; it was intended to be used for small articles, such as snuffers, scissors, &c., instead of forging them.

Mr. Adams inquired about the application of the hardened iron to tires. The best scrap tires were found the worst to wear; they laminated more, and, consequently, he did not use them. Those he used were made, he believed, of two blooms, the lower one of scrap or other tough iron, and the upper one from a puddled ball not piled; the wearing surface was, consequently, crystalline iron, hard, not laminated, and was more suitable to resist the rolling and crushing action that the wearing surface of the tire was subjected to.

Mr. Stirling replied that he had seen a similar process extensively carried on; the lower part of the tire was made of No. 3 iron, and the wearing surface of No. 2 iron, consisting of two puddled balls hammered thoroughly, then reheated and passed through rolls, and lastly welded to the No. 3 iron for the lower part. For such purposes as the wearing surfaces of wheel tires and rails, scrap iron was certainly the worst, from the inequality of the pieces united by weldings, necessarily numerous and

irregular; when the wearing and rolling action came into effect, unequal wear and lamination of the surface must be the result.

Mr. T. Fairbairn said the results of the trials he had made of the toughened cast iron were a near approximation to Mr. Hodgkinson's experiments; but he did not think it would be prudent, or altogether safe, for an architect or engineer to reduce the section of a girder to the extent which the relative transverse strength given in the tables would appear to warrant; he would rather retain the large section, and avail himself of the additional security which the use of the toughened iron undoubtedly gave.

Mr. Stirling observed that, to obtain the full increase of strength, would require different trials with different iron, in order to ascertain the best proportion of scrap; but, in the right proportions, from the general results of observations, he believed it might be confidently stated that one-fifth of the weight might be taken from ordinary sections of girders, by using the toughened cast iron, leaving a greater strength of girder; however, he would much prefer seeing all the strength of the ordinary section left for extra safety. The strengths given in the tables in the paper were chiefly taken from Mr. Hodgkinson, and were the average results of his experiments, showing an increase of transverse strength of 78 per cent.

Mr. R. Williams asked whether, in practice, any difficulty was found to arise in uniting the two qualities of hard and soft wrought iron?

Mr. Stirling replied, that no difficulty was found in the manufacture, and they were found to be soundly welded together.

Mr. R. Williams observed that, as the hard iron, which melted at a lower temperature than the soft iron, was necessarily the topmost in the pile, when placed in the furnace to be welded, either that would be overheated at the expense of its quality, or the inner piles would be underheated, and endanger the soundness of the bloom. With regard to the lamination of tires, this was not so much owing to the fact of their being made of piled iron, as to the mode of piling; and, by piling the bars edgeways instead of flatways, there was little, if any, liability to laminate. Puddled iron could be made hard or soft, at pleasure, according to the management of the process, without the introduction of any alloy into the puddling furnace.

Mr. Stirling replied, that the hard iron came quite as soon to a welding heat as the other iron, and a most perfect weld resulted.

Mr. M'Connell remarked that, in the manufacture of steel tires, the steel did not lengthen so much as the iron in rolling, and it made a difficulty in rolling the tires, to make them sound throughout; and he inquired whether any difficulty of that kind was found with the hardened iron for the wearing surface of tires and wheels?

Mr. Stirling replied that, in rails, no separation between the materials had been found; he had not yet had experience in tires. On the Edinburg and Glasgow Railway, on the steep incline, at Cowlairs, Mr. Adie had had rails hardened on this plan laid down for some years, and had found them to last better than steel-covered rails, which had been also tried, and usually wore out in a considerably shorter time; the hardened rails were still going on well, and an additional portion of that line was now being laid with them. In consequence of the first rails manufactured

being made too hard, they showed distinctly a tendency to separate, and the failure was valuable as experience; also, they were made more liable to separate, by the hardened piece laid on being round-topped in the pile; 50 or 60 rails, made at the very first works where the plan had been tried, had been broken at different times, for examination, and were found quite sound.

Mr. E. A. Cowper said he had used wrought-iron scrap mixed with cast iron in the ladle, the metal being rather hotter than usual; it closed the grain of the iron very much, and was found advantageous in casting hydraulic presses, or other castings where a very close grain was required. He had put in as much as 15 per cent. of scrap.

Mr. Stirling observed that he had never found that more than about 5 per cent. could be combined in that manner, and then the mixture must be more or less imperfect, and the metal would be partially chilled.

Mr. Cowper said he had not found any objection from the metal being cooled; it was taken pretty hot, and clean iron turnings were put into the ladle, and well stirred up, which secured complete mixture and fusion.

Mr. Slaughter inquired, what was the relative cost of toughened cast iron?

Mr. Stirling replied that, in a girder, if the section were reduced one-fifth, the cost would be cheaper; if the price of cast iron were very low, the toughened iron would then be proportionately dearer.

Mr. Slaughter said he had tried the toughened iron for a number of locomotive cylinders, at the recommendation of Mr. Gooch, on the Great Western Railway, and found it made very fine, perfect, and sound castings, better than he had ever made before. He intended to continue the use of it, and considered it an excellent material for cylinder castings, and preferable for any purpose for which the strongest and best iron was required. He did not find the iron dearer, but, on the contrary, less expensive than the iron he had previously used for the purpose.

Mr. Stirling explained that the toughened iron might be made from a cheaper iron, such as the Scotch hot-blast, which, at £3 per ton, would be about £3 10*s*. for the cost of the toughened iron, which would then surpass in strength a dearer iron, such as Blaenavon, at £5 or £5 10*s*. per ton; so that, although the increased expense of the process was 10*s*. or 12*s*. per ton, the final cost was less, because a cheaper description of iron could be used, and a greater strength was at the same time obtained, as shown in the table of experiments.

Mr. Slaughter said he had found that the toughened iron was less expensive. That which he used was made from Dundyvan or Calder iron, at £3 or £3 10*s*. per ton, and he found it better, when toughened, than the cold-blast iron which he had previously used, at £5 or £5 10*s*. per ton.

The chairman proposed a vote of thanks to Mr. Stirling, for his valuable and interesting paper, which was passed. He thought that important practical results were likely to follow from such an able investigation, and they were much indebted to Mr. Stirling for bringing it before them; and he trusted that he would continue the course, and favor the institution with the further results.

Description of a new Process of Stereotype Moulds; with Notices of the History and Results of the Processes of Stereotyping. By DANIEL WILSON, LL. D., F. S. A., Scot. V. P.*

Dr. Daniel Wilson, in exhibiting this new method, stated that it was calculated to facilitate the process, and to introduce it into more general use, by diminishing the cost. In introducing the subject he reverted to the curious fact—by no means singular in the progress of inventions—that, in the economic adaptation of printing to its fullest extent, by means of stereotype plates, we are returning to a state of things nearly similar to the "block books," as they are called, which, in the beginning of the fifteenth century, preceded the great discovery of movable types, and by means of which the first essays in printing were made by Guttenberg, Faust, and Mentz. Dr. Wilson also called attention to the character of a certain class of bronze Roman stamps, of common occurrence, several of which he exhibited, both from Scottish localities and from Pompeii. These were obviously designed to be used for impressing certain characters, by means of a pigment applied to the flat surface, like types or woodcuts; and afford one of those curious examples so frequently seen in relation to modern inventions, of others—many centuries previous to their practical application—having trod, as it were, on the very threshold of the discovery. He then entered on the subject of stereotyping, or the process of taking casts from forms of movable types. The discovery of this important process was made by William Ged, a goldsmith of Edinburgh, about the year 1725; though imperfect attempts had been previously made to attain the same important end by Van der Mey, of Leyden, by soldering together the forms of ordinary movable types for a quarto bible, so early as 1711. Dr. Wilson exhibited to the meeting one of the original plates of the edition of Sallust published by Ged in the eighteenth century, and interesting, as the first specimens of the practical application of the stereotyping process ever executed. He then detailed the various efforts at further improvement on this process—including those of Brunell, Allan, Sinclair, &c.; after which he described and exhibited the new process introduced by him to the notice of the society, which consists in taking the casts of the types, not in gypsum or stucco, but in blotting paper, overlaid with a thin layer of whiting, starch, and flour-paste, covered with a sheet of tissue paper, and impressed on the types by means of beating it with a fine brush. It is then dried on a hot steam-chest, while still adhering to the types; and by this means a matrix is produced, and the types are again ready for distribution to the compositors within one hour. The advantages of the new process are—1st, The greater certainty of the process, the new matrix not being liable to warp or break, as the stucco is. 2d, The greater rapidity; the process being completed in one hour by it, which could not be done in less than six by the other. 3d, The practicability of using the matrix, in certain cases, for casting several plates; whereas the stucco mould is always destroyed in a single casting. And, 4th, The much greater simplicity of the apparatus required; which, added to the economy of time, and the consequent diminution of the

* From the London Artizan, April, 1853.

quantity of type required for the compositors, give the important economic results which form the great merit of the new plan. A mould was made and a cast taken in presence of the meeting; and Dr. Wilson concluded by remarking that he believed it was by the improvement and more general application of such processes as this, that the great desideratum of cheap literature was to be achieved, and not by diminishing the profits of retail booksellers, as had recently been attempted. If publishers could be induced to try it, there was no real obstacle in the way of applying the stereotyping process, with all its adjuncts, to such standard works as Layard's "Nineveh," or Macaulay's "History of England," than to Mrs. Stowe's "Uncle Tom;" and if the publisher calculated his price for editions of ten, twenty, or thirty thousand of the one, as they had already done of the other, people would learn to purchase, instead of merely borrowing a hasty reading from some lending library. This, he thought, was the direction in which we must now look for securing the grand desideratum of cheap literature of the highest class, in a way that would secure at once the best interests of author, publisher, and readers; whereas, by reducing the profits of the retailer on the present costly two or three guinea editions, the price was, in reality, brought no nearer the means of the ordinary reader; while the bookseller's interest in their sale, and even in their publication, must be greatly diminished with the increase of his risk; and the chance of sale of costly and valuable books was thereby not unlikely to be diminished.

For the Journal of the Franklin Institute.

U. S. Screw Steamship Princeton. By B. F. Isherwood, Chief Engineer U. S. Navy.

Continued from page 51.

Performance with the Ericsson Screw.

The following table gives the result of all the steaming done with the Ericsson screw recorded in the log; much more steaming was done with it than is here given, but no record was kept of the performance of the machinery.

The data in the table is wanting in several elements; the consumption of fuel, the proportion of the throttle open, and the condenser back pressure, are not given. I have been informed, however, by the engineers of the vessel at that time, that the throttle was carried about $\frac{1}{4}$th open, and the steam pressure maintained by driving the fan blast very strongly, the back pressure in the condenser averaging 2 pounds per square inch. Under these circumstances, the initial cylinder pressure would be about 3 pounds less than the boiler pressure.

But the data in the table is chiefly valuable as giving the *slip* of the Ericsson screw in sea navigation, and although the means are derived from a less extensive course of steaming than could be desired to ensure positive certainty, yet they are from a sufficient number of observations taken under different circumstances of weather to give the results with enough accuracy for practical purposes.

Table of the Performance of the U. S. Screw Steamship Princeton, with the first boilers and Ericsson's Screw, under Steam assisted by Sail, on the Atlantic Coast of the United States.

DATE.	Number of hours.	Speed of the vessel per hr. in knots of 6082⅔ feet.	Course of the vessel.	WIND. Direction.	WIND. Kind.	Sail.	Sea.	Mean draft of vessel.	ENGINES. Steam pressure in boilers per sq. in. above atmos.	ENGINES. Steam cut off at from commencement of stroke.	ENGINES. Double strokes of piston made per minute.	Slip of the screw in per centums of its speed.
								ft. in.	lbs.			
1844. Mar. 15,	10	6·000	N. by E.	E. or abeam.	Moderate Wind.	To topsails.	Rough.	15 8	19·3	⅓	28·70	39·44
Nov. 26,	24	8·719	S. by W.	Abeam.	Fresh breeze.		Moderate.	17 4	16·5	"	29·50	14·55
1845, Jan. 8,	21	8·798	N.	N. E. or forward beam.	Moderate Wind.		"	16 9	15·4	"	27·70	8·00
Feb. 2,	6	8·000	W.	N. or abeam.	Fresh breeze.		"	17 0	13·8	"	25·00	7·31
" 4,	7	8·000	S. W.	N. W. or abm	"		"	16 6	14·6	"	25·00	7.31
" 21,	3	8·667	S. E.	S. W. or abm	Moderate brreeze.		"	17 0	15·7	"	28·33	11·40
Means,		8·226						16 9⅝	16·1	⅓	27·98	15·01

Performance under Steam, unassisted by Sail.

DATE.	Number of hours.	Speed of the vessel per hr. in knots of 6082⅔ feet.	Course of the vessel.	WIND. Direction.	WIND. Kind.	Sail.	Sea.	Mean draft of vessel.	ENGINES. Steam pressure in boilers per sq. in. above atmos.	ENGINES. Steam cut off at from commencement of stroke.	ENGINES. Double strokes of piston made per minute.	Slip of the screw in per centums of its speed.
1844. Jan. 4.	15	7·733	N. E.	N. E. or ahead.	Moderate breeze.	None.	Smooth.	16 8	10·8	⅓	31·26	28·34
Feb. 11.	12	8·083	S. W.	N. W. or abeam.	Fresh breeze.		"	17 6	18·2	"	31·25	26·08
Mar. 14.	13	5·365	N. E.	N. or forward beam.	Moderate Wind.		Rough.	15 10	20·5	"	28·77	45·99
Nov. 27.	18	5·250	S. W.	W. or " "	Strong Wind.		Heavy ahead.	17 6	15·5	"	26·11	41·76
Dec. 9.	24	8·333	N.	N. or ahead.	Moderate breeze.		Smooth.	17 0	16·6	"	29·46	15·61
1845. Jan. 6 & 7.	7	8·071	S.	N. or aft.	Light airs.		"	16 10	13·7	"	27·07	13·62
" 24	8	6·600	E. S. E.	S. E. or ahead.	Moderate Wind.		Rough.	17 6	15·0	"	25·95	20·33
Feb. 2.	18	5·417	N. W.	N. N. W. or ahead.	Fresh Wind.		"	17 0	14·5	"	23·05	31·93
" 3.	10	8·600	N.	Forward the beam.	Light. breezes.		Moderate.	16 9	14·5	"	26·00	4·19
" "	6	5·710	NE by E	S. or on quar	Light airs.		Smooth.	16 9	7·7	"	17·17	3·67
" 4	17	6·280	N. W.	N. W. or ahead.	Moderate breezes.		Moderate.	16 7	15·2	"	24·00	24·21
" 22 & 23	38	7·069	S. W.	S. or forward beam.	Light breeze.		Smooth.	16 10	15·0	"	27·67	26·00
Means.		6·912						16 10⅝	15·6	⅓	26·98	25·79

Summary of the Results with the Ericsson Screw.

	Performance under steam assisted by sail.	Performance under steam unassisted by sail.	Mean of the total performance.
Total number of hours,	71	196	267
Speed of the vessel per hour in knots of 6082⅔ feet,	8·226	6·912	7·261
Steam pressure in boilers in lbs. per sq. in. above atmosphere,	16·1	15·6	15·7
Proportion of throttle open,	¼	¼	¼
Initial steam pressure in cylinders in lbs. per sq. in. above atmos.,	12·1	11·6	11·7
Steam cut off at from commencement of stroke of piston,	⅓	⅓	⅓
Back pressure in condensers in pounds per square inch,	2	2	2
Mean effective pres. in lbs. pr sq. in. of pistons throughout stroke,	15·3	14·9	15·
Horses power developed by the engines,	404·23	379·59	386·14
Double strokes of piston made per minute,	27·98	26·98	27·25
Slip of the screw in per centums of its speed,	15·01	25·79	22·92
Mean draft of vessel in feet and inches,	16 9⅝	16 10⅝	16 10⅜
Immersion of the centre of the screw below the surface of the water,	9 9⅝	9 10⅝	9 10⅜
Immersed amidship section of the hull in square feet,	358·	360·5	360·5
Displacement of hull in tons,	1028·5	1037·4	1035·3

Performance of the U. S. Screw Steamship Princeton, with the first boilers and Stevens Screw, under the command of Commodore Stockton, in the Atlantic Ocean and Gulf of Mexico.

DATE. 1845.	Number of hours.	Speed of the vessel per hr. in knots of 6082⅔ ft.	Course of the vessel.	WIND. Direction.	WIND. Kind.	Sail.	Sea.	Mean draft of vessel. ft.	Mean draft of vessel. in.	Slip of the screw in per centums of its speed.	ENGINES. Steam pressure in boilers per sq. in. above atmosphere. lbs.	ENGINES. Double strokes of piston made per minute.	ENGINES. Steam cut off at from commencement of stroke.	Anthracite burned per hour with fan blast. lbs.
April 7,	14	9·100	N. E. by N.	S. or on qur.	Light breeze.	All sail.	Smooth.	17	0	17·09	18·0	34·30	⅓	2700
May 6,	10½	7·400	W.	E. by S. or aft.	"	"		17	8	11·35	6·8	20·50	"	1040
" 8,	12	9·200	W by N	N. or abeam.	"	"		17	6		12·7	28·40	"	2217
" 9,	24	9·067	"	"	Mod. wind	"		17	6	3·19	10·6	27·46	"	1715
" 10,	24	8·567	"	"	Light "	"		17	4	2·22	9·5	27·38	"	1434
" 11,	11	8·705	N. W. by W.	N. or forw'd. the beam.	"	"		17	3	1·44	10·0	27·60	"	1042
" 11,	7	7·250	"	N.W. or ahd.	"	No sail.		17	3	9·37	10·0	25·00	"	1022
" 12,	10	8·100	N. W.	N. E. or abm.	"	All sail.		17	2	1·66	9·9	24·90	"	960
June 25,	16	8·531	E. by S.	E. S. E. or ahead.	Moderate breeze.	No sail.		17	3	8·07	12·3	29·00	"	1440
" 26,	8	8·375	S. E. by E.	E. or forw'd. the beam.	"	"		17	1	11·28	12·2	29·50	"	1224
" 26,	16	8·797	E.	E. or ahead.	"	"		16	11	6·20	12·2	29·31	"	1332
" 27,	24	8·427	S. E. by E.	S. E. or ah'd.	"	"		16	9	10·35	12·1	29·38	"	1344
" 28,	20	7·412	E.	E. or ahead.	"	"		16	8	18·88	12·0	28·55	"	1208
" 28 and 29,	18	8·903	N. E. by E.	E. or forw'd. the beam.	Fresh brez	All sail.		16	6	1·72	10·6	28·31	"	1181
June 29,	8	7·406	N.	W. or abeam.	Light "	"		16	6	2·05	6·0	28·63	"	624
" 30,	24	8·354	N N E.	W. or on qr.	Fresh "	"		16	5	1·90	7·8	25·62	"	720
July 1,	8	7·750	"	N'd. & W'd. or abeam.	Light "	"		16	4	9·46	12·0	26·75	"	804
" 1,	16	5·719	"	N. E. or ah'd.	Mod. "	No sail.		16	4	24·75	9·8	23·75	"	768
" 2,	24	6·692	N. E.	N'd. & E'd. or ahead	Light "	"		16	3	16·48	8·0	25·04	"	844
" 3,	20	8·250	N. W.	N'd. & E'd. or abeam.	Mod. "	All sail.		16	2	1·41	6·8	26·15	"	674

Summary of the Results from the above Table.

	Performance under steam assisted by sail.	Performance under steam unassisted by sail.	Mean of the total performance.
Total number of hours,	183½	131	`3 4½
Speed of the vessel per hour in knots of 6082⅔ feet,	8·515	7·615	8·140
Steam pressure in boilers in lbs. per sq. in. above atmosphere,	10	11	10·4
Proportion of throttle open,	¼	¼	¼
Initial steam pressure in cylinders in lbs. pr sq. in. above atmos.,	6	7	6·4
Steam cut off at from commencement of stroke of piston,	⅓	⅓	⅓
Back pressure in condensers in pounds per square inch,	2	2	2
Mean effective pres. in lbs. pr sq. in. of pistons throughout stroke,	10·7	11·4	11·0
Horses power developed by the engines,	274·01	295·92	283·14
Double strokes of piston made per minute,	27·12	27·49	27·27
Slip of the screw in per centums of its speed,	1·88	13·43	6·69
Mean draft of vessel in feet and inches,	16 11	16 7⅝	16 9½
Immersion of centre of the screw below the surface of the water,	9 11	9 7⅝	9 9½
Pounds of anthracite burned per hour with a fan blast,	1283	1147	1226
Immersed amidship section of the hull in square feet,	361·8	352·6	358
Displacement of the hull in tons,	1041·1	1007·9	1027·4

Table of the Performance of the U. S. Screw Steamship Princeton, under the command of Capt. Engle, with the first boilers and Stevens Screw, under steam assisted by sail, in the Atlantic Ocean and Gulf of Mexico.

Date.	Number of hours.	Speed of the vessel per hr. in knots of 6082⅔ ft.	Course of the vessel.	WIND. Direction.	WIND. Kind.	Sail.	Sea.	Mean draft of vessel. ft.	in.	Slip of the screw in per centums of its speed.	ENGINES. Steam pres. in boil. pr sq. in. abv. atmo. lbs.	ENGINES. Double strokes of piston per minute.	ENGINES. Steam cut off at from com. of stroke.	ENGINES. Propor. of throttle open.	ENGINES. Back press. in condenser per gauge.	Anthracite burned pr hr. with moder. fan blast. lbs.
Sept. 7 and 8, 1845,	43	7·400	S. W. ½ W.	S. E. or abeam.	Gentle brez.	"	"	17	3	1·17	8·7	23·40	⅓	⅛	2·2	1120
" 9 " 10, "	31	6·100	"	N. E. or aft.	Light "	"	"	17	1	11·75	9·4	21·60	⅓	⅛	2·2	851
Oct. 1, 2 and 3, "	60	7·587	S. W.	S. E. or abeam.	Mod. "	"	Moder.	17	5	11·53	11·0	26·80	⅓	¼	2·2	1652
July 17 and 19, '46,	24	7·460	N. E.	Abaft the beam.	" "	To topsails.	Smo'th	16	4	1·42	12·3	23·65	⅓	⅛	3·2	859
" 30 and 31, "	24	7·750	S. S. W.	E. or abaft the beam.	" "	To royals.	"	17	11	2·50	10·6	23·63	⅓	·32	2·2	923
August 22, "	3	8·750	S. E. by E. ½ E.	S. S. E. or forward beam.	" "	Fore&aft sails.	Moder.	17	6	1·27	10·0	27·00	⅓	⅜	2·7	1700
September 6, "	12	7·667	N. N. E. ½ E.	N'd. & E'd. or for'd. beam.	" "	"	Smo'th	18	0	10·60	11·8	26·80	⅓	¼	4·2	1360
" 7, "	8	8·000	"	" " "	Light "	To topsails.	"	17	10	3·84	12·3	26·00	⅓	3-16	4·2	1350
" 9 & 10, "	42	8·810	"	Abeam.	Mod. "	To topgallants	"	17	7	2·35	13·2	28·20	⅓	7-32	4·2	1724
" 14 & 15, "	36	8·000	S. S. E.	E. or abeam.	" "	"	"	18	1	4·25	12·5	26·11	⅓	7-32	3·5	1761
" 16, "	18	7·800	S. by E.	" "	" "	To royals.	"	17	11	0·51	12·7	24·50	⅓	⅛	3·7	1450
" 17, "	7	6·730	S. E. ½ S.	E. or forward the beam.	" "	Fore&aft sails.	Moder.	17	9	10·07	13·0	23·57	⅓	3-16	3·4	1429
" 19 & 20, "	23	6·217	S. S. E.	" " "	Strong "	"	Rough.	17	6	12·25	13·0	22·14	⅓	3-16	3·4	1552
Oct. 2 and 3, "	36	5·200	N. N. E.	" " "	Light "	To topgallants	Smo'th	16	6	18·62	7·6	13·70	⅓	1-32	4·4	511
Oc. 31, & Nv. 1, "	39	5·570	S. S. W.	W. N. W. or abeam.	Mod. "	"	Moder.	17	8	19·41	10·5	21·60	⅓	5-32	3·7	1146
Nov. 2 and 3, "	36	6·717	"	E. or abeam.	" "	"	"	17	6	4·58	10·4	22·00	⅓	3-16	3·7	1183
" 3 and 4, "	15	6·600	"	" "	Light "	"	"	17	5	6·08	9·5	21·96	⅓	⅛	3·2	1114
" 4 and 5, "	27	6·900	"	N. W. or on quarter.	Mod. "	"	"	17	4	5·38	10·6	22·79	⅓	3-32	3·4	933
January 25, 1847,	12	6·400	W. ½ S.	N. or abeam.	Light "	"	"	16	8	10·31	10·0	22·30	⅓	¼	3·	1356
Mar. 29, 30, 31, "	54	7·156	N. N. E. ½ E.	E. or abeam.	Mod. "	"	Smo'th	17	9	12·27	9·7	25·49	⅓	¼	2·5	1656
Means,		7·071						17	5	6·46	10·7	23·61	⅓	·170	3·1	1290

Table of the Performance of the U. S. Screw Steamship Princeton, with the first boilers and Stevens Screw, under steam alone, in the Atlantic Ocean and Gulf of Mexico.

DATE.		Number of hours.	Speed of the vessel per hour, in knots of 6082⅔ feet.	Course of the Vessel.	WIND. Direction.	WIND. Kind.	Sea.	Mean draft of vessel. ft.	in.	Slip of the screw in per cents. of its speed.	ENGINES. Steam pressure in boiler per square inch above atmos. lbs.	ENGINES. Double strokes of piston per minute.	ENGINES. Steam cut off at from commencement of stroke.	ENGINES. Proportion of throttle open.	ENGINES. Back pressure in condenser per gauge. lbs.	Anthracite coal burned per hour with moderate fan blast. lbs.
August 7,	1845.	14	6·278	S.	S. E. or for'd the beam.	Light breeze.	"	17	0	10·00	10·5	21·80	⅓	3-16	2.	1063
September 5 and 6,	"	32	7·400	S. W. ½ W.	S. W. or ahead.	" "	"	17	6	15·91	11·4	27·50	"	¼	2·2	1600
Sep. 15, 16, 17, 18 & 19,	"	101	7·399	N. E.	N. E. or ahead.	Gentle "	"	16	8	15·83	11·7	27·47	"	¼	2·2	1508
October 3 and 4,	"	24	8·000	S. S. W.	S. W. or ahead.	Light "	Smooth.	16	4	9·76	10·8	27·70	"	¼	1·2	1854
Oct. 24, 25, 26 & 27,	"	96	5·240	N. N. E.	N. and E. or ahead.	Fresh wind.	Heavy head sea.	16	9	32·89	11·2	24·40	"	9-32	2·7	2154
May 12 and 13,	1846,	25	7·000	S. S. W.	S. S. W. or ahead.	Light breeze.	Ordinary.	18	0	8·85	11·4	24·00	"	7-32	2·7	1402
" 20 and 21,	"	25	6·682	S. by W ½ W.	N. E. or on quarter.	Light airs.	Smooth.	17	10	8·00	12·4	22·70	"	⅛	2·2	1130
July 14, 15 and 16,	"	49	6·555	N. N. E.	N. E. or ahead.	Mod. breeze.	"	16	7	13·93	12·6	23·80	"	5-32	3·	1129
" 19,	"	12	5·750	N. N. E. ½ E.	E. S. E. or abeam.	" "	Moderate.	16	5	21·87	13·0	23·00	"	3-16	2·7	1067
" 29,	"	12	6·481	S. S. W.	S. E. or abeam.	Light airs.	Smooth.	17	10	8·00	12·0	23·50	"	3-16	2·2	1442
August 1,	"	6	6·000	S. S. W. ½ W.	" "	Light breeze.	"	18	0	14·77	9·8	22·00	"	⅛	2·2	900
September 7 and 9,	"	31	8·001	N. N. E. ¼ E.	N. E. or ahead.	" "	"	17	9	8·00	12·8	27·18	"	¼	4·2	1726
" 17,	"	8	7·367	S. E. ½ S.	Variable.	Gentle "	Moderate.	17	9	9·00	13·0	25·30	"	¼	3·7	1870
" 17, 18 & 19,	"	37	6·430	S. E.	E. S. E. or for'd. beam.	Mod. "	"	17	8	17·92	13·3	24·48	"	7-32	3·7	1892
" 19,	"	9	6·333	S. ½ E.	E. or abeam.	" "	"	17	7	14·69	12·7	23·20	"	3-16	3·7	1583
" 21 and 22,	"	36	6·111	S. by E. ½ E.	S. E. or for'rd the beam.	" "	Long swell.	17	4	15·24	12·7	22·53	"	3-16	3·7	1548
October 1 and 2,	"	15	3·900	N. N. E.	S. and E. or on quar.	Gentle "	Smooth.	16	7	8·00	8·9	13·28	"	1-32	4·7	637
November 3,	"	3	5·000	S. S. W.	S. W. or ahead.	Mod. "	Moderate.	17	6	28·02	10·0	20·30	"	3- 6	3·7	1200
" 3 and 4,	"	24	6·412	"	S. E. or abeam.	Light "	"	17	5	8·33	9·3	21·86	"	5-32	3·2	1154
" 12 and 13,	"	31	5·174	N. by W. ¾ W.	N. W. or for'd the beam.	Light airs.	Smooth.	17	2	25·14	10·[illegible]	21·60	"	3-16	3·	1106
" 17 and 18,	"	19	3·184	—	Ahead.	Gale.	Heavy head sea.	16	10	46·47	9·9	18·59	"	3-16	3·7	1248
" 20,	"	12	5·400	N. W.	N. W. or ahead.	Strong wind.	Mod. head sea.	16	9	15·60	9·8	20·00	"	3-16	3·5	1183
January 26,	1847,	20	6·000	W. ½ S.	N. or abeam.	Calm.	Smooth.	16	9	15·92	10·0	22·30	"	¼	3·	1160
Means,			6·843					17	1	17·79	11·5	24·11	⅓	·216	2·9	1511

Table of the Performance of the U. S. Screw Steamship Princeton, with the last boilers, under steam assisted by sail, in the Atlantic Ocean and Mediterranean Sea.

Date.	Number of hours.	Speed of the vessel per hr. in knots of 6082⅔ ft.	Course of the vessel.	WIND. Direction.	WIND. Kind.	Sail.	Sea.	Mean draft of vessel.	Slip of the screw in per centums of its speed.	ENGINES. Steam pres. in boil. pr sq. in. abv. atmos.	ENGINES. Double strokes of piston per minute.	ENGINES. Steam cut off at from com. of stroke.	ENGINES. Propor. of throttle open.	ENGINES. Back press. in condenser per gauge.	Anthracite burned pr hr. with a mod. fan blast.
								ft. in.		lbs.				lbs.	lbs.
July 25 & 26, 1847,	24	9·542	E.	S. or abeam.	Fresh breez.	To topgallants	Moder.	17 6	20·7	12·2	24·71	⅓	1-31	2·2	854
" 30, "	18	5·830	E. by S.	S. S. W. or for'rd beam.	Light "	"	"	17 4	27·19	10·6	23·60	⅓	1-24	2·2	968
August 2, "	8	7·000	S. E.	E. N. E. or for'd. beam.	Gentle "	To topsails.	Smo'th	17 1	9·79	13·0	24·25	⅓	⅛	2·2	925
" 10, 11&12 "	47	8·413	S. E. by E.	S. W. or abeam.	Mod. "	To topgallants	Moder.	17 3	5·76	11·8	27·90	⅓	3-16	2·2	1294
" 13 & 14, "	40	8·224	"	N. E. or abeam.	" "	"	"	17 1	4·03	11·6	26·88	⅓	3-16	2·2	1428
September 13, "	10	6·200	"	S. W. or abeam.	Gentle "	"	Smo'th	16 8	13·89	12·5	22·50	⅓	⅛	3	845
" 22, "	7	5·430	E. N. E.	S. E. or forward beam.	Light "	To Topsails.	"	17 5	21·33	11·5	21·57	⅓	⅛	3	914
Dec. 3 and 4, "	36	6·143	E. by S.	N. E. or forward beam.	Mod. Gale.	"	Rough.	17 6	20·01	11·7	24·00	⅓	3-16	2·5	1167
" 5, "	21	8·100	"	" "	Strong wind	"	Moder.	17 5	5·72	13·0	26·85	⅓	3-16	2·	1154
January 7, 1848,	12	7·830	W. by N.	S. W. or forward beam.	Mod. breeze.	"	"	16 9	7·97	11·5	26·59	⅓	¼	2·5	1467
" 26, "	3	7·500	E. by S.	N. or abeam.	Light "	"	"	16 10	15·39	12·7	27·67	⅓	¼	2·5	1697
March 5 and 6, "	14	7·150	"	S. W. or on quarter.	" "	"	Smo'th	17 2	9·03	12·3	24·64	⅓	3-16	2·5	1915
" 19, "	12	7·333	N. N. E. ¾ E.	E. by S. or abeam.	Moderate.	Fore, aft & courses.	"	16 9	15·12	12·3	27·00	⅓	⅓	2·5	1824
Means,		7·580						17 2½	7·76	12·3	25·68	⅓	·163	2 3	1253

Table of the Performance of the U. States Screw Steamship Princeton, with the last boilers, under steam unassisted by sail, in the Atlantic Ocean and Mediterranean Sea.

Date.	Number of hours.	Speed of the vessel per hr. in knots of 6082$\frac{2}{3}$ ft.	Course of the vessel.	WIND. Direction.	WIND. Kind.	Sea.	Mean draft of vessel.	Slip of the screw in per cents of its speed.	ENGINES. Steam press. in boil. pr sq. in. abv. atmo.	ENGINES. Double strokes of piston per minute.	ENGINES. Steam cut off at from com. of stroke.	ENGINES. Propor. of throttle open.	ENGINES. Back press. in condenser per gauge.	Anthracite burned pr hr. with a mod. fan blast.
									lbs.				lbs.	lbs.
July 31, & Aug. 1 & 2, '47,	64	6·303	S. E.	S. E. or ahead.	Light breeze.	Smooth.	17 3	17·96	11·9	24·01	$\frac{1}{3}$	$\frac{1}{8}$	2·5	1093
August 3, 4, 5, 6, & 7, "	106	6·218	S. E. by E.	" "	Strong "	Rolling.	16 10	20·14	12·2	24·33	$\frac{1}{3}$	$\frac{1}{8}$	2·5	1193
" 13, "	5	7·600	"	S. W. or abeam.	Light "	Moderate.	17 1	8·65	11·8	26.00	$\frac{1}{3}$	3-16	2·5	1444
September 10 and 11, "	32	4·155	"	S. E. or ahead.	Mod. Gale.	Very Rough.	16 10	38·34	13·4	21·06	$\frac{1}{3}$	$\frac{1}{8}$	3·	1182
" 16, "	9	5·000	N. E.	N. E. by E. or ahead.	Mod. breeze.	Smooth.	16 9	32·36	12·0	23·10	$\frac{1}{3}$	3-16	3·2	1438
" 21, "	4	5·750	E.	——	Calm.	"	17 6	20·14	12·0	22·50	$\frac{1}{3}$	$\frac{1}{8}$	3·	828
" 22 and 23, "	10	5·856	N. E.	——	"	"	17 5	15·47	12·7	21·65	$\frac{1}{3}$	$\frac{1}{8}$	3·	830
" 28, "	9	6·220	S. E.	E. or forward the beam.	Strong breeze.	"	17 6	21·53	12·0	24·77	$\frac{1}{3}$	$\frac{1}{8}$	3·	1245
" 29, "	18	5·330	E. by N.	E. or ahead.	" "	Moderate.	17 5	30·01	13·0	23·80	$\frac{1}{3}$	$\frac{1}{8}$	3·	1170
October 6 and 7, "	13	5·700	S. S. E.	S. E. or for'd. the beam.	Light "	Smooth.	17 5	21·53	12·3	22·70	$\frac{1}{3}$	$\frac{1}{8}$	2·7	1008
Oct. 12, 13 and 14, "	42	5·452	S. E.	S. or forward the beam.	Strong "	"	17 2	25·27	12·2	22·80	$\frac{1}{3}$	3-16	2·7	2153
Nov. 3, "	15	5·400	E. by S.	N. E. or for'd the beam.	Light "	"	17 6	28·80	13·0	23·70	$\frac{1}{3}$	3-16	2·5	1177
" 12, "	6	5·670	S. W. by S.	N. N. W. or on quarter.	Strong "	Rough.	16 9	26·70	13·0	24·17	$\frac{1}{3}$	3-16	2·5	1100
" 14 and 15, "	10	6·500	S. W. $\frac{1}{2}$ S.	(Not given.)	Light "	Smooth.	17 6	17·43	13·8	24·60	$\frac{1}{3}$	3-16	2·6	1160
December 28, "	5	6·150	S. E. by S.	N. E. or abeam.	" "	"	17 2	23·12	14·0	25·00	$\frac{1}{3}$	3-16	2·2	1120
January 6 and 7, 1848,	32	6·375	W. by N.	S. W. or for'd the beam.	" "	"	16 9	19·55	12·0	24·75	$\frac{1}{3}$	$\frac{1}{4}$	2·5	1250
" 21 and 22, "	17	7·294	N. E.	N. W. or abeam.	Light airs.	"	17 6	15·58	11·7	27·00	$\frac{1}{3}$	$\frac{1}{4}$	2·5	1527
" 25 and 26, "	15	6·328	W. by N.	N. W. or for'd the beam.	Strong breeze.	Moderate.	16 10	23·53	11·8	25·86	$\frac{1}{3}$	$\frac{1}{4}$	2·5	1619
" 27, "	10	7·400	E. by S.	S. E. or for'd the beam.	Light "	Smooth.	16 8	13·61	10·8	26·60	$\frac{1}{3}$	$\frac{1}{4}$	2·5	1662
March 2 and 3, "	20	5·150	W. by N.	W. by N. or ahead.	Strong wind.	Rough head sea.	17 6	33·08	12·0	24·05	$\frac{1}{3}$	$\frac{1}{4}$	2·2	1615
" 15 and 16, "	16	5·683	"	S. W. or for'd the beam.	Strong breeze.	Smooth.	17 0	28·07	12·5	24·69	$\frac{1}{3}$	$\frac{1}{4}$	2·2	1865
Means,		5·932					17 0$\frac{3}{8}$	22·76	12·3	24·00	$\frac{1}{3}$	·168	2·5	1245

Summary of the Performance of the U. S. Screw Steamship Princeton, while under the command of Captain Frederick Engle, U. S. Navy, embracing all the Steaming done between July 25, 1845, *and July* 17, 1849, *recorded in the Steam Logs at the Navy Department.*

	With the first boilers and Stevens' screw, in the Atlantic Ocean and Gulf of Mexico.			With the last boilers and Stevens' screw, in the Atlantic Ocean & Mediterranean Sea.		
	Under steam assisted by sail.	Under steam alone.	Mean of total steam'g, with and without sail.	Under steam assisted by sail.	Under steam alone.	Mean of total steam'g with and without sail.
OBSERVED.						
Total number of hours,	550	641	1191	252	458	710
Speed of vessel per hour in knots of 6082⅔ feet,	7·071	6·343	6·680	7·580	5·932	6.517
Steam pressure in boilers in pounds per square inch above atmosphere,	10·7	11·5	11·1	12·3	12·3	12·3
Steam pressure in cylinders in pounds per square inch above atmosphere,	5·7	7·5	6·6•	7.3	7·3	7·3
Double strokes of piston (and revolutions of screw) per minute,	23·61	24·11	23·88	25·68	24·00	24·60
Steam cut off at from commencement of stroke of piston,	⅓	⅓	⅓	⅓	⅓	⅓
Proportion of throttle open,	·170	·216	.195	·163	·168	·166
Back pressure in condensers, in lbs. per square inch,	3·1	2·9	3.	2·3	2·5	2·4
Pounds of anthracite coal burned per hour, with a moderate fan blast,	1290	1511	1409	1253	1245	1248
Tons of anthracite coal burned per 24 hours, with a moderate fan blast,	13·82	16·19	15·10	13·42	13·34	13·38
Mean draft of vessel in feet and inches,	17·5	17·1	17·3	17·2½	17·0⅝	17·1¼
Immersion of centre of screw below surface of water in feet and inches,	10·5	10·1	10·3	10·2½	10·0⅝	10·1¼
Immersed amidship area of hull in sq. ft	376·7	364·3	371·8	370·5	365·2	368·
Displacement of the hull in tons,	1096·1	1050·3	1077·8	1073·2	1053·7	1061·7
CALCULATED.						
Slip of screw in per cent. of its speed,	6·46	17·79	12·58	7·76	22·76	17·21
Mean effective pressure on pistons in pounds per square inch,	9·40	9·95	9·70	11·40	11·20	11·27
Horses power developed by engines,	209·56	226·52	218·67	276·43	253·82	261·84
Pounds of coal burned per hour per square foot of grate surface,	9·627	11·276	10·515	9·213	9·155	9·176
Pounds of coal burned per hour per sq. foot of heating surface,	0·533	0·624	0·582	0·418	0·415	0·416
Cubic feet of steam of atmospheric pressure furnished per minute, from sea water of twice the natural concentration, with temperature of feed water* 100° F., inclusive of loss by blowing off to maintain that concentration, and of loss between valves and pistons and in steam ports, but *exclusive* of the steam required to work the fan blast,	. . .	. . .	3689·850	. . .	. . .	3926·524
Pounds of steam evaporated per hour, from one square foot of heating surface, under the above conditions,	. . .	. . .	3·363	. . .	. . .	2·887
Pounds of steam evaporated per hour, by one pound of coal, under the above conditions,	. . .	. . .	5·777	. . .	. . .	6.940

*A Hint Respecting the Barometer.**

The purpose for which the Barometer was originally designed, and which ever since its invention it has been supposed actually to accomplish, is *to measure the weight* of the atmosphere, and this it certainly does effect in one sense of the word, but not in its generally received sense. By the weight of any heavy body, such as a cannon ball or a carriage wheel, we invariably understand the weight of that body when free from motion, and this weight is always a just criterion of the quantity of matter which the body contains; but in weighing the air by the barometer, we only obtain its weight modified by the degree of speed with which it may be passing along at the time. Its barometric weight, therefore, except in a perfect calm, without either upper or lower current, which perhaps seldom or never happens, must perpetually differ from its real or dead weight, and for this reason cannot rightly be regarded as a perfect measure of its mass. Hence it is plain that if the air is a fluid with a well defined surface covering the earth in a simular manner to the sea, and subject to elevations and depressions resembling the tides of the ocean, these atmospheric tides increasing or decreasing at any place in proportion to the volume of air collected there, can never be accurately ascertained by the barometer without reference also to the velocity of the wind, by making due allowance for which we alone can arrive at its real weight, and consequently at its quantity. In order to obtain a rough estimate of the amount of the correction which it thus appears to be necessary to introduce into the readings of barometric observations on this account, I took for data those recorded in the *Nautical Magazine* for the years 1835 and 1836. In the column marked "Force of the Wind," the minimum degree, or No. 1, was first searched for, there being no calm noted during those years, and wherever that number occurred, the heights of the barometer, given in the parallel columns, were carefully extracted. The mean of them was then taken, and in like manner the mean corresponding with every other degree of force up to No. 11, which is the highest registered. The following is the result of these calculations:—

Force of Wind.	Mean Barometer.	Force of Wind.	Mean Barometer.	Force of Wind.	Mean Barometer.	Force of Wind.	Mean Barometer.
No. 1	30·19	No. 4	29·92	No. 7	29·67	No. 10	29·51
2	30·03	5	29·87	8	29·54	11	29·40
3	29·98	6	29·77	9	29·49		

By this table it will be seen at a glance that the barometer falls with every degree of increase in the velocity of the wind, and not only is this the case, but I think it will appear also that this fall of the mercury proceeds according to a known natural law. In treating of centrifugal motion, it is usual to illustrate it by supposing a heavy body, a ball or bullet for instance, attached to the end of a string, whilst the other end is held in the hand, and thus becomes a central point, around which the bullet is made to revolve. By this revolution the string receives a pull outwards,

* From the Nautical Magazine, May 1853.

the force of which may be completed by the following proportion.—(See Barlow's *Math. Dict.* Art.: Central Forces.)

As the radius of the circle it describes
Is to double the height due to its velocity;
So is the weight of the body,
To its centrifugal force.

Applying this rule to the motion of the air round the earth, we must suppose the atmosphere to be the bullet, and the earth's radius the string; then calling the latter r, and the weight of the former b, and putting v for the velocity of the wind in feet per second, $2g = 32\frac{1}{6}$ for the force of gravity, and f for the centrifugal force, we shall have, from the laws of falling bodies, according to the same author,

$$4\ g^2 : v^2 :: g : \frac{v^2}{4g} = \text{the height due to its velocity.}$$

Whence, by the same proportion,

$$r : \frac{v^2}{2g} :: b : \frac{bv^2}{2gr} = f, \text{ the centrifugal force.}$$

Now if we multiply the square of v by b, which latter, if it be made to represent the average weight of the air, is a constant quantity, and if we divide the product by $2g = 32\frac{1}{6}$, which is also a constant quantity, and by r, or the radius of the earth, which is another constant quantity, then as v^2 is the only variable quantity, the results will only vary with this quantity, and in the same proportion. Consequently f, or the centrifugal force with which the air is pulled upward by the wind, is directly as the square of the velocity; and this force, expressed in terms of the barometric scale, being added to the observed height, will give the true height, corresponding to the dead weight of the superincumbent air.

It now remains to show how far this theory accords with observation, and for this purpose I place the results of each side by side.

Force of Wind.	Number of Observations.	Mean Barometer.	Barometer according to Theory.	Force of Wind.	Number of Observations.	Mean Barometer.	Barometer according to Theory.
No. 1	190	30·19	30·02 01	No. 6	139	29·77	29·77 11
2	255	30·03	30·01 03	7	82	29·67	29·66 13
3	355	29·98	29·98 05	8	45	29·54	29·53 15
4	196	29·92	29·93 07	9	14	29·49	29.38 17
5	247	29·87	29·86 09	10	14	29·51	29·21 19
6	139	29·77	29·77	11	5	29·40	29·02

The perfect agreement of seven of these results, from Nos. 2 to 8 inclusive, out of eleven, is most remarkable. Had the observations been

more numerous from which the remaining four were derived, the latter three in particular, there is every reason to believe that the same agreement would have been apparent. Whether the winds classed under the first degree in the meteorological register could have fallen short of the force assigned to them, and ought to have been reckoned as 0, I know not, but so we should be led to suspect from the above hypothesis, and also that 3, 4, 5, &c., should be twice, thrice, &c., the velocity of No. 2, instead of three, four, and five times that of No. 1. But, however we may decide upon this point, the results will still be found in sufficiently close accordance with observation, to prove beyond doubt the correctness of the theory on which they are founded. J. N.

For the Journal of the Franklin Institute.

United States Auxiliary Screw Steamship Massachusetts. By B. F. Isherwood, Chief Engineer, United States Navy.

Continued from page 63.

The Massachusetts as a Sailing Vessel.—The following is the performance of the *Massachusetts* under sail alone, the screw being hoisted entirely out of water. As much sail was carried as could be advantageously set, and the sea was generally in its ordinary state, with a moderate swell on.

	Knots per hour.
With light breezes forward the beam, the mean of 78 hours sailing was	3·654
" moderate " " " " 227 "	4·555
" fresh " " " " 124 "	6·242
With light breezes abeam, the mean of 533 hours sailing was	4·209
" moderate " " " 476 "	5·622
" fresh " " " 316 "	6·000
With light breezes abaft the beam, the mean of 123 hours sailing was	3·683
" moderate " " " " 244 "	6·246
" fresh " " " " 183 "	8·000

By comparing the above performance under sail alone, with the performance under sail and steam for the same conditions of wind, &c., the value of the auxiliary steam will clearly appear as follows:

Under sail alone, with light breeze forward the beam, speed,	3·654	knots per hour.
" sail and steam, " " " "	4·511	"
Increase of speed due to steam, 23·45 per centum, or	0·857	"
Under sail alone, with light breeze abeam, speed,	4·209	"
" sail and steam, " " "	5 516	"
Increase of speed due to steam, 31·05 per centum, or	1·307	"
Under sail alone, with light breeze abaft the beam, speed,	3·683	"
" sail and steam, " " " "	6·157	"
Increase of speed due to steam, 67·18 per centum, or	2·474	"

The mean performance under sail alone, averaging the speed, with a light breeze forward the beam, abeam, and abaft the beam, is 3·849 knots per hour. The same mean for sail and steam, under the same con-

ditions of wind, is 5·395 knots per hour, or an increase of 40·17 per centum.

Of the whole amount of steaming done, 43 per centum was performed under steam alone, against a gentle breeze, and at a speed of 4·320 knots per hour. Against a moderately strong wind, under steam alone, the vessel could not make steerage way.

An observation of the large amount of slip given by the screw under all circumstances, clearly shows how much its efficiency had been sacrificed to obtaining a hoisting out arrangement. For this purpose, it was necessary to make the screw light, and to have it light, it must be of small diameter; the consequence of which was a propelling surface insufficient for the mass to be driven, and a resulting great loss by slip. Much of this, however, could have been obviated by giving the screw a considerably less pitch, and proportionably increased rotary velocity. The six blades on a screw of 9½ feet diameter are at least two too many, and the same projected area could be obtained with four blades, a reduced pitch, and same length on axis. The form of the screw seems to have been designed with a view to obtain the largest possible amount of friction surface on the water—the hollow braces of the hub, the drum, and unnecessary number of blades all largely swelling that formidable item, not to mention the direct resistance of their additional cutting edges, &c. The thickness of the hub proper is also out of proportion greater than the thickness of the blades. It is not probable that this type of screw will ever be imitated, as it entails many disadvantages, and no advantages, except the ease with which a spare blade could be fitted on, in the event of breaking one.

Performance of the U. S. Auxiliary Steamship Massachusetts, under steam alone.

Date.	Number of hours.	Speed of the vessel per hour in knots of 6082⅔ feet.	Course of the vessel.	Wind.		Engines.					Slip of the screw in per cents of its speed.	Consumption of Pennsylvania anthracite coal in pounds per hour.
				Direction.	Kind.	Steam press. in boil. per sq in abv atmos.	Number of double strokes of pist'n made per minute.	Steam cut off at from commencement of stroke of piston.	Proportion of throttle open.	Back pressure in condenser in pounds per square inch.		
April 11, '50,	24	4·688	—	—	Calm.	30	38·00	½	Wide.	2	37·46	510
" 12, "	18	3·722	NbyW	N. or ahead.	Mod. brez.	29	37·00	"	"	2	49·01	534
June 20, "	14	4·250	E N E.	N. & E or "	Light "	22	30·00	"	"	2	30·69	460
" 25, "	14	4·696	N. W.	N. W. or "	" "	29	37·25	"	"	2	36·10	555
Aug. 12, "	16	5·391	—	Abeam.	Light airs.	24	36·92	"	"	2	26·00	615
Oct. 22, 23, and 24, "	50	4·600	N. W.	N. and W. or ahead.	Very light breeze.	25	40·00	"	"	2	41·71	626
Oct. 29, "	13	4·308	NNW.	"	Light airs.	25	39·25	"	"	2	44·36	576
June 5, 6, 7, and 8, '51,	81	5·444	—	—	" "	25	41·47	"	"	2	33·46	682
June 13, "	3	3·500	E,	E. S. E. or on bow.	Mod. breze	25	35·00	"	"	2	49·55	500
" 14, "	24	3·792	EbyN.	E. or ahead.	Light "	25	36·70	"	"	2	47·62	771
July 13, 14, "	22	3·137	S. W.	S. W. or "	" "	22	35·52	"	"	2	55·23	566
" 16, 17, and 18 "	50	3·100	S. W.	S. & W. or "	" "	20	33·00	"	"	2	52·38	581
Aug. 27, "	6	5·500	—	—	Calm.	27	40·00	"	"	2	30·30	810
" 13, 52	10	3·400	S. W.	N&W.orabm.	Light brez	23	35·00	"	"	2	50·76	450
Sep. 2, 3, "	15	5·133	S.	W. or abeam.	Light airs.	28	39·20	"	"	2	33·63	685
" 12, 13, "	17	3·794	S. E.	S. or on bow.	" "	25	37·35	"	"	2	48·51	611
" 17, 18, "	31	3·758	—	On bow.	" "	29	36·22	"	"	2	47·41	686
Oct. 2, 3, "	11	3·773	S. W.	S.W.or ahead	Light brez	26	36·30	"	"	2	47·31	670
Means,		4·320				25	37·55	½	Wide.	2	41·68	621

Performance of the U. S. Auxiliary Screw Steamship Massachusetts, under steam assisted by sail.

WITH THE WIND FORWARD THE BEAM.

Date.	No. of consecutive hours.	Speed of the vessel per hour in knots of 6082⅔ feet.	Course of the vessel.	WIND.		ENGINES.					Slip of the screw in per centums of its speed.	Consumption of Pennsylvania anthracite coal in pounds per hour.
				Direction.	Kind.	Steam press. in boil. per sq. in. abv. atmos.	No. of double strokes of piston made per minute.	Steam cut off at from commencement of stroke of piston.	Proportion of throttle open.	Back pressure in condenser in pounds per square inch.		
April 6 & 7, 1850,	23	5·620	W.	S'd. & W'd.	Light brez.	31	39·53	½	Wide.	2	27·94	477
" 10, "	12	5·500	NbyW	N'd. & E'd.	"	35	40·00	"	"	2	30·29	550
June 18, "	4	5·625	—	—	"	25	38·00	"	"	2	24·96	410
August 5, "	12	5·667	S. S. E.	S. W.	"	24	38·00	"	"	2	24·62	520
May 1, 1851,	11	4·545	NbyE.	N'd. & W'd.	Mod. brez.	26	36·00	"	"	2	36·03	510
" 10, "	12	5·333	E.byS.	Southerly.	Light brez.	25	39·00	"	"	2	30·68	740
June 15 & 16, "	44	4·318	"	E. N. E.	"	25	36·75	"	"	2	40·44	738
July 18, 19, 20, and 21, "	65	3·170	W.	S'd. & W'd.	Mod. brez.	20	31·84	"	"	2	49·33	713
July 23 & 24, "	18	3·170	S. W.	"	"	19	30·91	"	"	2	48·01	738
August 3, "	20	5·450	W.	"	Fresh brez.	20	37·00	"	"	2	25·33	625
" 28 & 29, "	33	5·546	N. W.	N.	Light brez.	24	38·95	"	"	2	29·04	847
Dec. 29, 1852.	5	4·700	NbyW	N. N. E.	"	24	36·00	"	"	2	33·82	675
Means,		4·511				24	35·94	½	Wide.	2	36·38	679
WITH THE WIND ABEAM.												
June 19, 1850,	27	6·227	—	—	Light brez.	25	37·60	½	Wide.	2	16·05	580
April 24, 1851,	13	4·615	N.	E. by S.	"	25	40·00	"	"	2	41·51	575
" 27, "	4	6·000	N. E.	N. N. W.	Mod. brez.	20	36·50	"	"	2	16·67	550
June 2, "	15	6·267	E. S.E.	N'd. & E'd.	Light brez.	25	42·40	"	"	2	25·07	704
" 3 & 4, "	48	5·834	"	North'ard.	"	25	38·90	"	"	2	23·98	724
" 11, "	6	5·750	"	N. E. by N.	"	25	40·00	"	"	2	27·13	550
" 17 & 18, "	37	5·730	E.½S.	South'ard.	"	25	41·35	"	"	2	29·75	685
" 23, "	10	6·000	N. E.	E. S. E.	"	25	41·00	"	"	2	25·80	867
Aug. 4 & 5, "	25	4·200	S. W.	N'd.&W'd.	"	20	33·00	"	"	2	35·47	738
Dec. 24, 1852,	9	4·000	S. E.	N. E.	"	25	36·00	"	"	2	43·67	562
Means,		5·516				24	38·76	½	Wide.	2	27·86	680
WITH THE WIND ABAFT THE BEAM.												
Aug. 4, 1850,	17	5·530	S. S. E.	W.	Light brez.	24	38·20	½	Wide.	2	26·62	522
" 5, "	8	6·250	N. W.	S.	" "	25	40·00	"	"	2	20·79	566
April 25, 1851,	3	4·667	N.	S. S. E.	Mod breze.	25	39·00	"	"	2	39·76	600
" 26, "	8	5·690	NbyE.	S.	Light brez.	25	40·00	"	"	2	27·89	638
June 20, "	24	6·291	E.byS.	W.	" "	25	41·40	"	"	2	22·96	704
" 21 & 22, "	48	6·230	"	W.	" "	25	41·63	"	"	2	24·14	803
Dec. 2, 1852.	4	9·000	E.	S. W.	Freshwnd.	28	44·00	"	"	2	3·52	690
Means,		6·157				25	40·84	½	Wide.	2	23·58	701
Mean of 3 Means,		5·179				24	37·87	½	Wide.	2	30·68	684

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*Wilkins's Steno-Telegraph, or the People's Penny Telegraph.**

Mr. J. W. Wilkins, of South-square, Gray's Inn, proposes to use only one wire for his telegraph, and to write the messages in a short-hand alphabet on strips of paper. He states that it is much more certain in its action than any other telegraph, and not liable to errors of any consequence. His principal improvements consist in a peculiar mode of insulating the wire, and in securing the full power of the electro-magnet, *in using the positive and negative currents* alternately, by which a great deal of time is saved in working the telegraph. The chief points upon which Mr.

* From Herapath's Journal, April, 1853.

Wilkins relies for the success of his plan and public support are certainty and rapidity of action, and simplicity and cheapness of construction. In addition to the advantages of cheapness of construction, he calculates on saving a considerable amount in the working expenses as compared with the expense of working other telegraphs, which will enable him to send messages at a much cheaper rate, and at the same time to realize ample returns on the capital invested. The saving in the working expenses depends entirely on the completeness of his mode of insulation. Owing to the present defective mode of insulation, he estimates that in general about nine-tenths of the power of the batteries is lost in that way, nearly the whole of which he expects to save on his plan. The patentee states that he is willing to undertake to lay down any length of line, including instruments, fittings up at stations, and patent right, for £20 per mile. The cost of materials for working the telegraph is stated to be 10s. per mile per annum; so that for an outlay of £2000, and £50 per mile per annum, a railway 100 miles in length may possess a telegraph, by the use of which the running of the trains on the line may be properly regulated, and numerous accidents prevented. It is obvious that the loss arising from one accident would be greater than the cost of construction and maintenance of such a telegraph in perpetuity, presuming it to be the business of the servants of the Company to attend to the telegraph.

Note on Inductive Electrical Machines, and on a Ready Means of Increasing their Effect. By M. Fizeau.*

The electrical machines which have been constructed of late years on the inductive principle are now well known; the constancy and regularity of their effects, as well as the facility of their employment, present marked advantages, which render these new machines preferable in some cases to those of the old construction.

Having undertaken some new experiments on the rapidity of the propagation of electricity, especially with the view of comparing in this respect electricity of tension with galvanic electricity, I found the employment of this apparatus very suitable for the purpose, but nevertheless that it would be useful to give greater power to the instrument, and especially to be able to increase the tension of the electricity furnished by it.

A very sensible increase of effect is obtained by employing a stronger pile to set the apparatus in action, and the electricity developed at the two poles of the machine acquires thus a very marked increase of tension. But this increase is accompanied by an inconvenience which deprives the instrument of its principal advantage, which consists in the regularity and the duration of its effects. One of the essential parts of the machine is M. de la Rive's vibratory contact-breaker. When the instrument is in action, very brilliant sparks are produced between the surfaces of the breaker, and although these surfaces may be formed of platinum, they are soon fused and destroyed when the current is rendered more intense; the vibrations becoming less constant in consequence, the production of electricity soon loses its regularity.

* From the Lond., Edinb., and Dublin Philosoph. Magazine, June, 1853.

The same inconvenience would no doubt be produced by giving the machine larger dimensions than those adopted by M. Ruhmkorff, for the force of the sparks which are produced at the point of vibration is due principally to the current induced in the conducting wire itself; and if the dimensions of the wires and the number of turns of the spire be increased, this current would of course become more intense and the sparks stronger.

But an attentive study of the peculiarities of the apparatus soon led to the discovery of an entirely different and very simple means of increasing the energy of the effects produced. Many experiments, which it would take too long to describe, tend to show that the current of induction which is produced in the inducting wire itself at the moment of the rupture of the circuit, exercises a considerable influence on the production of electricity in the induced wire which terminates the two poles of the machine. When this current is produced freely and takes a great development, the poles give but little electricity; but when, on the contrary, this current meets with obstacles, and only attains a slight development, the poles give much electricity, and the power of the machine becomes greater. Several arrangements served to prove this fact; I may mention the employment of metals more fusible than platinum on the surfaces of the breaker, and the union of the vibrating parts by fine wires of different lengths. This principle being admitted, it follows, that in order to increase the power of the machine, it is sufficient to oppose the development of the current which is produced in the inductor wire at the moment of the rupture of the circuit, and it is easy to see that this result must be obtained by acting upon the tension possessed by this current and rendering it weaker. In fact, when the machine is in action, the great light of the sparks which appear at the point of rupture, indicates that the current in question acquires a great development, and this is the case because the electricity possesses sufficient tension to pass with facility the space which separates the vibrating pieces: if the tension became weaker, the space to be passed presenting a constant resistance, the passage would not take place with the same facility, the sparks would be less brilliant, and the current would acquire a smaller development.

A very efficacious mode of diminishing the tension is to have recourse to the well-known properties of the Leyden jar, and other apparatus founded on the same principle. A condenser is formed of two leaves of tin in juxtaposition, but separated and insulated from one another by a layer of varnish, and each of the leaves put into communication with each extremity of the inductive wire; the points of attachment must be on both sides of the point of interruption when the sparks are produced. Then the two electricities, before arriving at the point of interruption, spread over the two surfaces of the tin, where they lose their tension to a great extent, in consequence of the mutual influence exercised across the isolating layer of varnish.

When the condenser presents a sufficient surface (5 or 6 square decimetres), the light is seen immediately to become weakened at the point of interruption, whilst the machine acquires a remarkable increase of energy; the poles then give stronger sparks and at a greater distance than before. The condenser may be conveniently placed in a horizontal posi-

tion, a little above the electro-magnet, and sustained by four glass supports. With this addition, which is very easily made, not only does the machine give more electricity, but it also continues longer in regular action, because the surfaces of the breaker are no longer exposed to the action of the very intense sparks which change them so rapidly.

An arrangement invented by M. Sinsteden, in which the principle of condensation has been employed to obtain stronger discharges with inductive machines, has only an apparent analogy with the method which I here indicate; the principle and the effects of the two methods being, in reality, very different. In fact, it is the electricity developed in the second wire, the inductive wire, which is modified by M. Sinsteden, so as to cause more brilliant sparks; but these stronger discharges are not accompanied by an augmentation of tension, which is, on the contrary, weakened. The employment of this method does not in any way injure the efficiency of that proposed by me, and they may both be employed together, where such a course is found advisable.

To furnish an idea of the increase of effect which I have obtained in my experiments, I will give the following observation. A galvanometer being placed in the circuit, the electricity produced by the machine was passed in rarefied air, when the beautiful phenomena of light recently studied by M. Quet were produced. When the machine acted under ordinary conditions, the needle of the galvanometer indicated a deviation of 8°. When the condenser was employed, the light produced acquired greater splendor, and the deviation of the needle reached 15°, the intensity of the current being consequently nearly double.—*Comptes Rendus, March* 7, 1853.

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*Purifying Apparatus of M. Bérard, for separating from Coal any foreign Substances which it may contain, such as Pyrites or Schist.**

The washing of coal, a system introduced into France within the last three or four years, is a branch of industry of the highest importance, permitting the use of coal which by its mixture with schist would not be otherwise employed. It may also be applied with advantage to certain coals, considered to be of good quality, but containing a quantity of ash, which diminishes the value. They are purified by this method in such a way as to allow of the manufacture of a coke from these coals, not containing more than three or four per cent. of ash. The Great Northern Railway of France has recognised the efficiency of this method, and a considerable part of the coke which it consumes is manufactured of washed coal; there result from its employment a marked economy of fuel, and a greater durability of the locomotives.

The expenses of washing, which are considerable by the ordinary method, are reduced to ten or twelve centimes (about a penny), per metrical ton† of fuel by M. Bérard's method. A very important desideratum may, therefore, be considered as obtained.

* From the Reports of the Juries of the Exhibition of the Works of Industry of all Nations, 1851. London.

† The metrical ton is equal to 1000 kilogrammes, or nearly an English ton, and contains 10 metrical quintals.—I. W.

The apparatus consists of three parts, viz:

1. An *elevator*, formed of an endless chain with buckets, which lifts from a trough or pit where the coals are placed a certain quantity, regulated by means of a valve.

2. A *separator*, into which the fuel is thrown by the elevator. This is composed of a long box, divided into compartments, and containing perforated plates, in stages, the size of the perforations being smaller and smaller by stages from the upper to the lower, so that by the shaking which this box undergoes, the coal is divided at once into four sizes. The finest powder falls to the bottom, and each of the three sizes of lumps being thrown out through openings in the sides of the box, into separate fixed sieves, called "bancs à lavage," which form the third part of the apparatus.

3. These "bancs à lavage" are long frames, measuring 9 feet 2 inches by 4 feet, of which the bottoms are pierced with holes, the diameter of which is smaller than that of the pieces of coal thrown into them. They are entirely filled with water, and divided in the interior into three parts. In one of these is a piston, which is worked up and down, and gives considerable motion to the water, which being communicated to the materials thrown on the bottom of the tank, these arrange themselves rapidly, in the order of their density, the heaviest being at the bottom. The pure coal alone comes to the surface, and by a current of water proceeding from a trough above, it is carried beyond the tank, and falls directly into the wagon, whence it is conveyed to its destination. The substances heavier than coal, such as schist or pyrites, are deposited on the perforated bottom of the tank, which has a slight inclination towards a trap, and thus constantly advance towards an exit. By a peculiar arrangement, the rubbish is thus made to carry itself into a compartment prepared inside of the tank, whence it is removed by the mere opening of a valve.

It will be seen from this description, that the work is continuous throughout, and requires no manual assistance. According to the declaration of M. Bérard, the quantity of coal that can be cleaned in an hour by a machine, the total cost of which would be 10,000 francs, (£400,) is ten to twelve metrical tons. The working of such a machine would not require more than about 2000 gallons of water per day (8 to 10 cubic metres).

The various specimens exhibited are as follows:

1. Coals classed in four sizes, and the foreign matters that have been separated from them.

2. Two specimens of coke; one made from coal as it comes from the mine, and the other from "washed coal." The first contains 26 per cent. of ash, the second only 2½ per cent.

3. A drawing of the apparatus.

The specimens are from an establishment founded by M. Bérard, at Molenbeck St. Jean, near Brussels.

M. Bérard states that his apparatus has been adopted by the mining companies of the Loire, Creuzot, Epinac, &c., in France, and that at the present time there is one being erected at Newcastle.

*Callen & Ripley's New Multiplying Rotative Power.**

A new multiplying rotative power has just been patented by Messrs. Callen and Ripley, of Parliament street, Westminster, by which the speed of any shaft, or other revolving body, can be increased or diminished without the use of cog-wheels, bands, or other gearing, hitherto in use. The loss of power, with the noise and danger attendant upon the use of cog-wheels, bands, &c., has been long and deeply felt, and the substitution of a safer, more efficient, and less costly mechanism, has engaged the attention of scientific men for many years without success, until this great desideratum has been at length attained, by the application of a circular grooved disk to the ordinary crank, thus producing a multiplier combining the most beautiful simplicity of construction with enormous strength and durability, at one-sixth of the present cost. The disk and crank transmit the motion with a perfectly uniform speed and power, without the least noise, and require only one-half of the space occupied by the present gearing; it is, therefore, not only of vast general utility, but pre-eminently applicable to steam-vessels, where the continual noise and clatter produced by cog-wheels has always been found so objectionable, while the small space required admits of its being easily fitted below the water-line, and clear of shot, which will be of great advantage in its application to our screw navy. Another, and not the least of the advantages of this invention, is, that not the slightest chance of accident to life or limb (so prevalent with cog-wheels and bands) can possibly occur, a boon which the manufacturing million will not be slow to appreciate. Taking into consideration the magnitude of the advantages possessed by this simple, yet important invention, it is not surprising to find that it should continue to engross the attention of the engineering and scientific world; nor is it, perhaps, too much to add, that a very short time must witness its universal adoption.

J. L. Stevens' Patent Smokeless Furnace.†

As "the time produces the man" for its particular emergency, so does it often elicit "the means" for attaining an immediately desired object, and just at the moment when the necessity for an efficient invention to prevent the formation of smoke, in all its frightfully increasing density and profusion, has become manifest, we have both the man and the means before us. The smokeless furnace invented and patented by Mr. John Lee Stevens, with whose scientific ability and persevering industry the readers of the *Mining Journal* cannot be unacquainted, appears to us to possess every requirement for the purposes for which it is intended; its leading points being novelty of conception and combination, united with extreme simplicity, cheapness of construction, and durability, unendangered by any movable parts; added to which, the labor of the fireman is absolutely simplified and lessened, instead of the contrary. We are enabled, with the assistance of the following diagrams, to give a tolerably

* From the London Mining Journal, No. 921.

† From the London Mining Journal, No. 921–923.

accurate description of this important invention—important to many, as effecting very considerable economy of fuel, and to all as the subduer of that modern enormity, universally known as the "smoke nuisance."

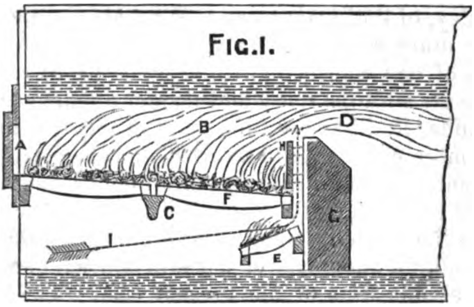
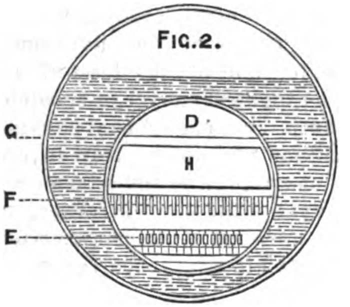


Fig. 1 is a longitudinal, and fig. 2 a transverse section, of a patent smokeless furnace, fitted in a Cornish boiler, conformably with the new system, which is alike applicable to every description of boiler, old or new.



A, doorway to the furnace, B, C; D, commencement of flue; E, the first, and F, the second, set of fire-bars; G, the bridge; H, calorific plate; I, the current of air. It will be seen that the invention consists in the combination of two sets of fixed fire-bars, the first of which is chiefly fed by the scoria and cinders voided from the second or upper set of fire-bars, with a calorific plate, the face of which may be protected by a few fire-bricks; by which arrangement the current of air entering at the lower part of the furnace passes through two strata of fire, and thence between the calorific plate and the bridge, and is thus so intensely heated as continuously to produce the entire combustion of the gaseous products of the fuel, and to prevent the ordinary formation of smoke. It is, in effect, a double furnace, confined to the limits of, and economically applicable to, any common description of furnace; has all the advantages of a hot-blast without the cost of any pneumatic apparatus; is so contrived as uniformly to distribute and keep up the requisite heat in boilers of whatever form; and whilst most effectually preventing the annoyance of smoke, and the usual deposit of soot in the flues, it causes an average saving of at least 20 per cent. in the quantity of fuel consumed, and also admits the substitution of the cheapest for that of a dearer quality, and of small instead of large coals, as further means of reducing the expense of consumption.

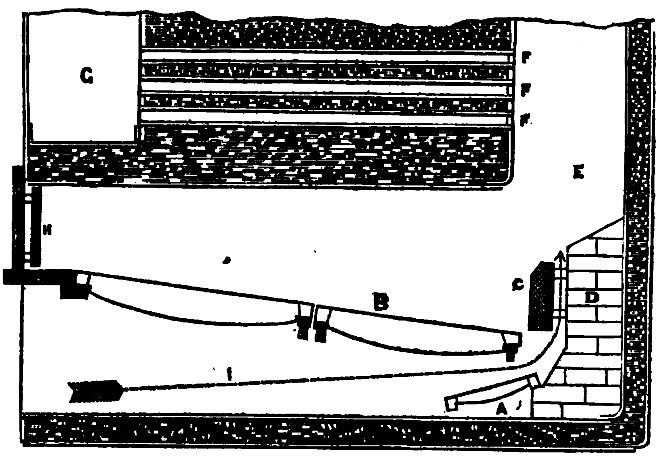
These claims to preferential consideration are now unquestionably sustained by the strong and concurrent testimonials in favour of the invention that have been submitted to us, and which place the saving in the cost of fuel a little in excess of the inventor's calculation, being in various proportions that range from 20 to 26 per cent.; and the highly respecta-

ble parties from whom they emanate agree in declaring that the smoke, visible only when the "hot blast" is suspended by the door being opened for a renewal of coals to the furnace, is reduced to the lowest possible minimum in quantity, thinness, and duration; and is, indeed, so light, as to be described as "a little smoky vapor." We may, therefore, hope very soon to see the last of the dense smoke, pouring out in thick and murky currents over and through the metropolis, from shafts and funnels innumerable, and hitherto indomitable. Nor will the benefits thus conferred on commerce specially, and on society universally, be confined to London—throughout the United Kingdom they will be shared, and, we doubt not, duly appreciated.

Mr. Lee Stevens has already succeeded with his invention, modified to suit the various forms of boilers respectively used by Messrs. Ward and Co., Grand Junction Wharf, and Mr. William Batley, engineer, Bridge-street Works, Northampton; Messrs. Samuel and William Standing, engineers, Osborn-street, Whitechapel; Messrs. Welch and Margetson, Cheapside; Messrs. Herring, Brothers, and Co., Aldersgate street; Messrs. Keens and Welch, Garlick-hill; the General Screw Steam Company's ship, the *Earl of Auckland*, &c.; and we understand is daily adding to the number, both in town and country.

The following diagram is a longitudinal section of the furnaces fitted to the boilers of the *Earl of Auckland*, Captain Wintle, belonging to the General Screw Steam Shipping Company, running between London and Rotterdam.

Fig. 3.



A first, and B second set of fire-bars; C, calorific plate, faced with fire-bricks; D, bridge; E, furnace-flue; F, boiler tubes; G, funnel-flue; H, furnace-door; and I, direction of current of air.

It will be obvious to any practical man that, in marine boilers constructed like those for the Royal Navy, which slope upwards from the ash-pit towards the furnace-flue, and so take from the furnace space the angle occupied by the brick bridge D, the invention will be adapted accordingly; the sloped water space forming the bridge.

On board the *Earl of Auckland*, after the most careful comparison with previous consumption, the ascertained saving in the expenditure for three consecutive voyages, out and home, with Welsh coals, is found to be more than 10 per cent.; and no doubt exists that, when the average has been taken for the same number of voyages with Hartley, or other similarly bituminous steam-coals, the economy of fuel will reach 20 per cent., independently of the comfort and advantages arising from the entire absence of dense smoke. A maritime friend of ours, who has witnessed the operation of the invention on board that steamer, besides corroborating the more material points in its favor, says that, as regards the subversion of smoke, "It is like striking the broad, black, piratical pennant, and running up a strip of thin brown bunting to signalize, for a moment, the putting on of fresh fuel." And to show of how much consequence (to some of them almost vital) the saving of fuel must be to our principal steam navigation companies, five of them could be named whose aggregate reduction, at 10 per cent. only, (that is, supposing nothing but Welsh coals were used) would amount to very nearly 100,000*l.* per. annum; and certainly to 150,000*l.* a year, if patent fuel or north country coals were consumed. What the saving will be on *land*, throughout the United Kingdom, computed at a fair average of 20 per cent., we leave to some ingenious reader to calculate.

Under these circumstances, we think the inventor, Mr. John Lee Stevens, has established the utility of his Patent Smokeless Furnace in a surprisingly short time, as well as in the most satisfactory manner. Independently of its preliminary use in Cornish boilers at Northampton, since October last, for the purpose of testing an invention on a working scale, and obtaining all the advantages of practical experience before the completion of his specification on 1st April, he has since then adapted it in London, and elsewhere, to Cornish, cylindrical, and wagon boilers, for engines varying from 4 to 60 horse power, on land; and with equal success to tubular marine boilers. In fact, the intrinsic merits of the invention—the simple, cheap, and effective supply of hot air for the purpose of thoroughly burning the gaseous products of the coal—have established for it a practical reputation that bids fair to ensure its universal adoption; wherefore it has our best wishes and disinterested advocacy.

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*Plumbic Zinc—A New Combination of Metals.**

Messrs. Morewood and Rogers, of Upper Thames-street, have recently patented a combination of lead and zinc, under the name of "plumbic zinc." It consists of distinct layers of each metal, perfectly united in a peculiar process of manufacture—one side thus presenting a surface of pure lead, the other pure zinc, combining the stiffness of the latter with the durability of the former. A sheet of metal is thus produced, which proves as hard and durable as one of lead several times its thickness and weight; while in peculiar situations the zinc is laid undermost, and is thus protected from atmospheric action, or the effect of acid vapors or liquors, by the preservative power of the lead. For every description of roofing,

*From the London Mining Journal, No. 921.

hips and ridges, gutters, pipes, cisterns, sinks, &c., this metal will most probably be found highly advantageous. For covering terraces, balconies, stairs, and passages, it will be found similar to lead under the feet; while the stiff lining of zinc will prevent it from treading out of shape. For chimney tops, cowls, &c., the lead is placed inside, which is indestructible from the sulphurous acids and vapors usually contained in smoke. For coal-boxes, baths, pails, and many other domestic utensils, it will also be found highly useful. Japan will adhere to it as well as to iron plate. It will solder as effectually as tin plate, and works softer and with greater facility than sheet zinc alone. It is also recommended for lining tunnels, sheathing ships, &c.; and no doubt numerous other uses will yet be found for it. We understand the Government authorities at Melbourne have contracted for a given period to secure the entire quantity which may be exported to Victoria for flooring and roofing many of the public and private buildings erecting in that city.

Process for Photographic Engraving. By H. F. Talbot.*

I beg to inform you that I have recently had the good fortune to advance another step in the path of photographic discovery; and as I am in hopes that what I have accomplished will prove of great practical utility, I have drawn up the following brief account of it:

Attempts have been made by several ingenious persons, especially on the Continent, to complete the daguerreotype process by engraving the plate impressed with the photographic image; that is to say, by causing it to engrave itself, by using chemical means only, and without requiring it to be touched in any way by the hand of an artist or engraver. Nor have these attempts been unsuccessful in themselves; on the contrary, specimens have been at various times brought over from Paris, quite sufficient to show that the thing is feasible. But the practical difficulties of execution have been such as to limit the utility of the invention; and I understand that the plates have been found to wear out after affording but a small number of impressions.

I have been so fortunate, however, as to discover a method, which I believe to be entirely new, of solving this interesting problem, which already in my hands succeeds with a reasonable degree of certainty for a large class of photographic objects, and which will doubtless be soon and greatly improved by other experimenters. I am now engaged in drawing up a full account of the process, which will be ready for publication in a few weeks; but in the mean time I trust you will permit me to sketch a general outline of the subject.

I will begin by referring to the labors of those who have preceded me in this line of research. The first person who turned his attention to this subject was Dr. Donné, of Paris, about the year 1840, as appears from the *Comptes Rendus* of the Academy of Sciences. I believe, however, that his attempts were not crowned with much success, and were soon discontinued. I have not seen any of the specimens which he executed. Dr. Berres, of Vienna, was, I think, the next to take up the subject. The

* From the London Athenæum, April, 1853.

specimens of his engravings which I have seen are of small size; they exhibit considerable sharpness in the outlines, but no half-tints or gradations of shade, the want of which produces a harsh effect. I understand that Dr. Berres' secret has never been disclosed. After him, the subject was resumed by M. Fizeau, of Paris, with considerable success. Some specimens which I have seen, stated to have been made by him, are beautifully distinct. But, notwithstanding that his process was taken up with a view to its improvement by more than one eminent photographer in London, I believe that its use has been discontinued, owing to the great uncertainties which attended it, and wearied the patience of the experimenters. There may perhaps have been some other experiments published, but the above mentioned are the chief processes of which I have seen specimens, or met with any published account. Some months ago, I resolved to take up this curious problem, as offering an interesting field of research and delicate experiment.

Abandoning the methods hitherto employed, which had not been found in practice sufficiently successful, I entered into a new path, which shortly gave me hopes that I was proceeding in the right direction. But as I advanced, difficulties appeared to multiply; and I found that on various occasions the results were most anomalous and contrary to all expectation. For instance, when I had prepared every thing, as I thought, to produce a positive etching of an object, the result was a negative etching of it. At other times half the plate was etched positively and the other half negatively, and of course such a result remained useless for any practical purpose. I here employ the term "*positive etching*," which I believe has not been used before, to imply an etching of such a kind that the impressions struck off from it represent the objects positively, or as they are in nature: and of course I employ the term "*negative etching*" in the opposite sense. The anomalous results which I at first obtained obliged me to submit to a careful investigation the photographic properties and the chemical reactions of a considerable number of substances, until at length the principal facts observed were satisfactorily explained, and the nature of the disturbing causes being known, the process was brought under control. And it was found that by comparatively slight changes in the mode of manipulating, either a positive or a negative etching could be produced at pleasure. But, of the two, the positive was the more perfect, and appeared also to be much more manageable than the other; which principal point being ascertained, I thenceforward devoted my attention chiefly to the perfecting of the positive process. I have now to mention to what point I have as yet succeeded in improving it. The objects most easily and successfully engraved are, those which can be placed in contact with the metallic plate, such as the leaf of a fern, the light feathery flowers of a grass, a piece of lace, &c., &c. In such cases the engraving is precisely like the object; so that it would almost seem to any one, before the process was explained to him, as if the shadow of the object had itself corroded the metal, so true is the engraving to the object. If a veil of black crape is laid upon the metal plate, every thread of it is engraved with wonderful precision and distinctness; and if two thicknesses of the crape are placed upon the metal, obliquely to each other, still the resulting engraving offers no confusion, but with the help

of a lens the lines belonging to each of the folds can be distinguished from those of the other.

Objects which cast a broad and uniform shadow, as, for instance, the opaque leaf of a fern or other plant, produce an etching, which, when printed off, delineates the original in a pleasing but unusual manner, something between an aquatint engraving and an indian ink drawing. But I have no doubt that a great variety of other effects will be found to be obtainable from the process. When the object to be copied is a photograph on paper, the process offers some difficulties which have not yet been entirely surmounted. Not that the engravings thus obtained are deficient in accuracy, for they follow the original with considerable minuteness of detail; but because the gradations of shadow and the depth of the etching upon the plate are found not to follow the same law as they do upon the original photograph. There is a much greater difference on the plate than exists in the original; the shadows are too deep and the lights are too strong. I am not without hope, however, that means of avoiding this may be discovered when the process shall be better understood. Some change or other in the manipulation may possibly be found to abolish this law of variation in the intensity of the shadows, and to substitute another more in conformity with nature.

I must not pass over a leading feature in my new process. It is this: I find that the *size* of the plate to be engraved makes no difference in the result of the process, except that it necessitates, of course, a greater degree of carefulness in the operator. Consequently, whatever degree of accuracy is obtainable on small plates is likewise obtainable on large ones; and this is a fact of considerable importance. For, the advantage of this new mode of engraving, the quantity of objects and details represented increases in proportion to the area of the picture, while the error or inaccuracy which affects each individual point is of constant magnitude. In large plates minute deviations from the outlines of the original, even if they exist, are of little consequence. They are merged and disappear in the general effect.

Lacock Abbey, April 4.

I now proceed to give you an account of my newly invented method of making photographic engravings upon steel. Of course, I have no need to observe that the art is at present in its infancy, but I have great hopes that it will very soon be considerably improved in all its details.

The first thing to be done is, to select a good steel plate, and to immerse it for a minute or two in a vessel containing vinegar mixed with a little sulphuric acid. The object of this is to diminish the too great polish of the surface; for otherwise the photographic preparation would not adhere well to the surface of the steel, but would peel off. The plate is then to be well washed and dried. Then, take some isinglass and dissolve it in hot water. The solution should be strong enough to coagulate when cold into a firm jelly. This solution of isinglass or gelatine should be strained while hot through a linen cloth to purify it. To this must be added about half as much of a saturated solution of bichromate of potash in water, and they should be well stirred together. When cold, this mixture coagulates into a jelly, which has very much the appearance

of orange jelly. The method of using it is, to liquify it by gentle heat, and to pour a quantity upon the centre of the steel plate. Then take a glass rod, hold it horizontally, and spread the liquid uniformly over the plate. Then incline the plate, and pour off the superfluous gelatine. Let the steel plate be placed upon a stand, and kept quite horizontal, that the liquid may not run to one side of the plate. Then place a spirit lamp beneath the plate, and warm it gently till the gelatine is quite dried up. When dry, the film of gelatine ought to be bright yellow and very uniform. If clouded bands appear upon the surface it is a sign that there is too little gelatine in proportion to the bichromate, which must therefore be corrected. The steel plate, now coated with gelatine, is ready to receive a photographic image of any object. First, let us suppose the object is one capable of being applied closely to the surface of the plate; for instance, et it be a piece of black lace or the leaf of a plant. Place the object upon the plate in a photographic copying frame, and screw them into close contact. Place this frame in the direct light of the sun for a short time, varying from half a minute to five minutes. Let it then be removed and the plate taken out, and it will be found impressed with a yellow image of the object upon a ground of a brown color, as might be expected from the well known photographic property of the bichromate. The plate is then to be placed in a vessel of cold water for a minute or two, which dissolves out all the bichromate and most of the gelatine also from the photographic image; *i. e.* from those parts of the plate which have not been exposed to the sun, being protected by the object; while, on the contrary, it dissolves little or none of the gelatine film which has been fully exposed to the sun's rays. The consequence of which is, that instead of a yellow image we have now a white one, but still upon a ground of brown. The plate is then removed from the water into a vessel of alcohol for a minute, and it is then taken out and placed upright on its edge in a warm place, where in the course of a few minutes it becomes entirely dried. This terminates the photographic part of the operation. If the plate is carefully examined while in this state, it appears coated with gelatine of a yellowish brown color, and impressed with a white photographic image, which is often eminently beautiful, owing to the circumstance of its being raised above the level of the plate by the action of the water. Thus, for instance, the image of a piece of black lace looks like a real piece of very delicate white lace of similar pattern, closely adhering to, but plainly raised above, the brown and polished surface of the plate, which serves to display it very beautifully. At other times the white image of an object offers a varying display of light when examined by the light of a single candle, which indicates a peculiar molecular arrangement in the particles of gelatine. These photographic images are often so beautiful that the operator feels almost reluctant to destroy them by continuing the process for engraving the plate.

In order to explain how such an engraving is possible, it is, in the first place, to be observed that the photographic image differs from the rest of the plate not only in color, but, what is of much more importance, in the thickness of the film of gelatine which covers it. The coating of gelatine on the rest of the plate is, comparatively speaking, a thick one, but that

which originally covered the image has been mostly removed by the action of the water, a small portion, however, almost always remaining. It therefore naturally happens that when an etching liquid is poured on to the plate, it first penetrates through the thin gelatine covering the image, and etches the steel plate beneath. But the next moment it penetrates likewise through the thicker coating of gelatine, and thus spoils the result by etching the whole of the plate. Nitric acid, for instance, does this, and therefore cannot be employed for the purpose. Since the other chemical liquids which are capable of etching steel have a certain analogy to nitric acid in their corrosive properties, they also for the most part are found to fail in the same manner.

This was a difficulty. But after some researches I found a liquid which etches steel perfectly well, and at the same time is free from the inconvenient property of penetrating the gelatine film. This liquid is the bichloride of platina. In order, however, to use it successfully, it must be mixed with a certain quantity of water, neither more nor less, (I mean to any material extent,) otherwise its action becomes irregular. The best way is, to make a perfectly saturated solution, and then to add to it one-fourth of its bulk of water. Then correcting this by a few trials, a solution of proper strength is finally obtained. Supposing, then, that we have prepared such a solution, the operation of etching the plate is performed as follows:—The plate is laid on a table, and a small quantity of the bichloride being poured upon it, it is to be rapidly diffused and spread over the whole plate with a camel-hair brush. Not much liquid is poured on, because its opacity would prevent the operator from distinguishing the effect produced by it on the metal. For this reason, it is hardly necessary to make a wall of wax round the plate; that is, if the portions to be etched are confined to the central part of the plate, and do not approach very near to the edge. The effect of the liquid upon the plate is not at first visible, since it disengages no gas; but after the lapse of a minute or two, the white photographic image begins to darken, and soon becomes black in every part. When this change is complete, the image often looks very beautiful, though quite altered from what it was before. The operator should carefully watch the image until he thinks that it is finished, or not likely to be further improved or developed by continuing the process any longer. He then inclines the plate gently, and pours off the liquid by one corner of the plate. The plate is then dried with blotting paper, and then a stream of salt water, which is better than fresh water for this purpose, is poured over the plate, which removes all traces of the etching liquid. The plate is then rubbed with a wet sponge or linen cloth, which in a short time detaches and removes the film of gelatine, and discloses the etching that has been effected. When the object is not of a nature to be applied directly to the surface of the plate, the most obvious method of proceeding is, of course, to place the prepared plate in the focus of a camera, and to direct the camera to the object. But in consequence of the low degree of sensitiveness of bichromate of potash, this would take, generally speaking, too long a time to accomplish. The better way in practice, therefore, is, to take a negative photograph of the object on paper with a camera, and from this to obtain a positive copy either on glass or paper, which should be very uniform in

texture, and moderately transparent. Then this positive copy is placed on the plate in a photographic copying frame, and being placed for a few minutes in the sun, it impresses the plate with a photographic image; which image, etched as above described, and printed off upon paper, will finally give a positive representation of the object. If the object depicted upon the plate by the sun's rays is broad and uniform, for instance, the opaque leaf of a plant, then, of course, the etching is uniform also. When this is printed off, it produces an effect which is not always satisfactory. I will therefore now explain a modification of the process which destroys this uniformity, and which in many cases produces a great improvement in the general effect.

For this purpose I must remark, in the first place, that if a piece of black gauze or crape is the object selected for representation, it produces an engraving of itself which is marvellously accurate. But when two folds of the gauze are laid across each other obliquely, then the resulting engraving requires a lens in order to separate from each other and distinguish clearly the lines belonging to the two portions of the gauze. Now, if this engraving is printed off, the result offers to an eye at a moderate distance the appearance of an uniform shading. Now, I avail myself of this circumstance, to modify my original process as follows: suppose the object to be the opaque leaf of a plant, of irregular outline; first, I cover the prepared plate with two oblique folds of black crape or gauze, and place it in the sunshine for two or three minutes. The effect of this is, to cover the plate with a complicated image of lines passing in all directions. Then the leaf is substituted for the crape, and the plate is replaced in the sunshine for two or three minutes more. The leaf being then removed from the plate, it will be seen that the sun has obliterated all the lines that were visible on the parts of the plate exterior to the leaf, converting all those parts to a uniform brown. But the image of the leaf itself is still covered with a network of innumerable lines. Now, let this be etched in the way already described, and let the resulting etching be printed off. The result is an engraving of the leaf, which when beheld by the eye at a certain distance appears uniformly shaded, but when examined closely is found to be covered with lines very much resembling those produced by an engraver's tool, so much so that even a practical engraver would probably be deceived by the appearance. This crape arrangement I call a *photographic veil:* and as I think it likely that the idea will prove useful, I will make a few more remarks upon it. It is clear that an arrangement composed of two thicknesses of ordinary crape or gauze is but a rude attempt at a photographic veil. To realize the practical utility that may result from the idea, supposing it to be borne out by further experience, it would be proper to fabricate a much finer material, and to employ five or six thickesses of it, or else to cover a sheet of glass in any convenient manner with an innumerable quantity of fine lines, or else with dots and specks, which must be opaque and distinct from each other. The result of practically employing such a method, supposing always that it answers in practice, as I think it probably will, would be an etching apparently uniform, but really consisting of separate small portions, in consequence of which it would hold the ink much better, and other obvious advantages would also be obtained. Another

mode of accomplishing the same object is to cover the plate originally with an aquatint ground. But then a fresh one would be required for every plate, whereas a single *veil* would serve for any number of plates in succession. Experience alone can decide between these different methods. When the etching is finished, the plate should be very soon coated with wax to protect it. A few hours' exposure to the atmospheric air rusts and destroys the etchings when newly made, although it does not do so afterwards. The oxidation only attacks the lines of the etching, the rest of the plate sustaining no injury, if the air is tolerably dry.

Having thus described the method of producing the photographic etchings, it would, I think, extend this letter to too great a length were I to add any remarks upon the theory of the process, which will better be deferred to another opportunity.

Lacock Abbey, April 25.

On the Composition of the Substances employed by the Chinese in the Decoration of Porcelain. By MM. Ebelmen and Salvetat.*

(Continued from page 36.)

2. *Blacks.*

The authors have analyzed four different specimens of blacks, namely, the black called *Si-fen-liao*, in the collection of the Musée Céramique, and the shining, dull, and bright blacks of the collection brought from Canton by M. Itier. The results are as follows:—

	Fen-liao. I.	Ou-kin. II.	Liang-he. III.	Tse-ho. IV.
Loss by heat,	14·20	25·60	3·20	16.60
Silica,	2·00	1·98	50·70	6·00
Oxide of lead,	69.14	59·58	25·00	traces
Oxide of copper,	4·60	8·40	5·80	5·40
Oxide of iron,	3·00			
Oxide of manganese, } Oxide of cobalt, }	7·00	1·70	10·02	70·00
Alumina,	0·24	0·62	0·52	0·40
Lime and Magnesia,	0·60	1·43	1·67	1·20
Alkali,	0·00	0·69	3·09	0·40

I. *Si-fen-liao.*—This is a brown powder with a greenish tinge. It effervesces strongly when treated with dilute nitric acid, and the solution presents all the characters of nitrate of lead. Before the blowpipe and with reagents it behaves like a mixture of white lead and an oxide of manganese containing cobalt.

II. *Ou-kin*, metallic black or raven-black, (ticketed *noir mat*).—This is in elongated fragments of the form of small sticks, or in irregularly rounded masses.

With reagents it behaves like *si-fen-liao*. It differs from that color in being made up into masses with size; but when this is removed, both colors consist of 5 parts of white lead and 1 part of the mineral called *thsing-hoa-liao*. It follows also from the analyses that this mineral must be of very variable composition.

In both these blacks the silica is only introduced by the gangue of the

* From the London Chemical Gazette, No. 243.

manganesian mineral, and this circumstance occurs also in other colors. It explains certain effects which may be remarked in the decoration of some Chinese porcelain, which are adorned with dull black or red ornaments, forming an agreeable contrast with the other well-glazed ornaments.

Laid on porcelain and exposed to the heat of the muffle-furnace, the two preceding colors only adhered in the thin parts. Where they were thicker, the oxide of lead was absorbed by the oxides, which in the absence of silica were incapable of forming a vitreous varnish. The thin portions, on the contrary, shone, because in these parts the small quantity of silica was sufficient to transform the oxide into silicate of lead.

III. *Liang-he*, shining black (ticketed *noir luisant*).—This is a brown powder, which must have been formed from a previously fused mass. With nitric acid it effervesced slightly, and the solution contained lead. Before the blowpipe it gave the reaction of cobalt. Oxide of manganese exists in it in smaller quantity than in the preceding colors.

IV. *Tse-he*, porcelain-black (ticketed *noir clair*).—This consists of dark greenish fragments, which are crushed with difficulty, and when burnt emit a distinct odor of burnt glue. It appears to be a mixture of *thsing-hoa-liao* with a size formed from bullocks' hides (*yeou-p'hy-kao*), which, according to Father Ly, is the solvent employed by the Chinese to render their colors fit for use. The silica, which forms 6 per cent. of the mass, is much contaminated with alumina; it is the gangue of the cobaltiferous mineral. The authors have tried this black as a blue under glazing; it gave blue designs perfectly resembling those which occur on many specimens of Chinese porcelain. As, however, the temperature of the furnaces at Sèvres is greater than that of the Chinese furnaces, the portions on which the oxides were thickly laid became inflated during the baking.

3. *Blues.*

The collection sent by Father Ly contains four different specimens of blue,—two in the rough state, and two completely prepared for painting. From the analyses it appears, that, in conformity with the statement made by Father Ly, there is no difference between the rough and prepared colors.

Seng-khouang-thsei, or rough blue of the first quality, requiring no addition of *yuen-feng;* it must be pounded (Ly).

This color is in well-fused, brilliant, transparent masses, of a fine sky-blue. It is frequently paler and opake in the interior of the masses; this appears to arise from imperfect fusion. When powdered, it is of a paler but pure blue color; and if treated immediately after this operation with dilute nitric acid, it does not effervesce.

Si-khouang-thsei, or prepared blue of first quality (Ly).—This is a powder which effervesces slightly with nitric acid from the presence of a little carbonate of lead. With acid it behaves like the preceding, resisting their action very well. Muriatic and nitro-muriatic acids discolor it completely after long boiling.

Sing-ting-thsei, rough blue of second quality, without need of *yuen-feng* (Ly).—This consists of perfectly transparant blue fragments. When

triturated, it furnishes a powder of a paler and more violet color than that given by the *khouang-thsei.* With acids it behaves like that color.

Si-ting-thsei, or prepared blue of second quality (Ly).—This is the powder furnished by pounding the preceding. It effervesces slightly with dilute nitric acid.

The following are the results of our analyses of these four colors:—

	Khouang-thsei.		Ting-thsei.	
	Seng.	Si.	Seng.	Si.
Loss by heat,	0·00	3·80	0·65	2·40
Silica,	48·21	46·40	38·81	37·20
Oxide of lead,	32·84	30·89	44·14	42·18
Oxide of cobalt,	1·50	1·60	0·68	0·50
Oxide of iron,	1·63	1·50	1·03	1·06
Lime,	0·97	0·35	0·83	0·64
Magnesia,	trace	trace	trace	trace
Potash and soda,	13·78	13·20	11·10	13·39
Oxide of copper,	1·00	0·96	0·50	0·15
Oxide of manganese,	0·50	0·62	1·00	1·00
Alumina,	0·06	0·15	0·50	0·50

In the second and fourth analyses, the loss includes the water and carbonic acid of the carbonate of lead formed by exposure to the atmosphere. The difference in the proportions of the oxides of cobalt and manganese explains the difference in the tint of these two blues; the second is paler and more violet than the other.

M. Itier brought the two following blues from Canton:

P'ao-lan, precious blue (ticketed *bleu foncé*).—This is a powder containing fragments. It resists the action of acids better than the preceding blues, but effervesces slightly with them. Under water it is seen to consist of two powders of different blues.

Tsing-fen, blue powder (ticketed *bleu de ciel foncé*).—This is a paler powder than the preceding. It effervesces slightly, and resists the action of acids rather less than the *p'ao-lan.*

The analyses of these two colors gave—

	P'ao-lan.	Tsing-fen.
Loss by heat,	3·00	1·40
Silica with traces of stannic acid,	60·80	47·20
Oxide of lead,	18·76	38·90
Oxide of cobalt,	1·62	0·50
Oxide of iron,	1·50	1·00
Lime,	1·08	0·64
Magnesia,	trace	trace
Potash and soda,	0·19	9·34
Oxide of copper,	1·00	trace
Oxide of manganese,	1·50	0·84
Alumina,	0·55	0·18

Thus all Chinese blues consist of a plumbo-alkaline glass colored with oxide of cobalt. The only difference between them lies in their various degrees of fusibility.

4. *Greens.*

All the greens employed in the decoration of porcelain in China are colored by oxide of copper, sometimes pure, sometimes rendered yellowish by the addition of prepared yellow, or bluish by the addition of white or of a harder flux.

The authors have only examined the rough colors, as, according to the

statements of Father Ly, the prepared colors would only differ from the rough ones in being triturated, or sometimes mixed with white lead.

Fei-thsei, rough green of first quality, to a pound of which 12 oz. of *yuen-feng* are added (Ly).

This is of a turquois-blue color; its powder is pale sea-green. Father Ly says, that when this color is of a coarse quality, it is mixed with *sy-chy-mo*. The authors think that it must be in a similar case that the large addition of *yuen-feng* mentioned above is necessary, as this addition does not appear to be required with the specimen in the Musée Céramique.

This color is produced by the fusion of white with the following green. In M. Itier's collection there are two greens of the same shade,—one which M. Itier calls light blue (*bleu clair*), and another which he names sea-green (*vert d'eau*).

Tcha-lan, light blue (ticketed *bleu clair*).—This is a fine powder of a pale turquois-blue. By immersion in water, two different powders are perceived in it,—one blue, the other white or grayish. The latter lowers the strength of the blue. The mixture effervesces slightly with nitric acid.

Chan-lou, mountain green (ticketed *vert d'eau*).—This is a homogeneous powder, very similar to the *fei-thsei* of Father Ly's collection. The color is derived from deutoxide of copper.

The analysis of these three greens gave the following results:—

	Fei-thsei.	Tcha-lan.	Chan-lou.
Loss by heat,	0·50	2·40	1·00
Silica with traces of stannic acid,	37·50	41·50	42·44
Oxide of lead,	44·13	43.40	43·40
Oxide of copper,	3·00	2·40	3·41
Alumina and oxide of iron,	trace	0·86	1·26
Lime,	0·25	2·11	2·00
Arsenic acid,	4·00	7·33	6·49
Potash and soda,	10·00		

The presence of an opake white is not necessary for the production of this tint with oxide of copper; the addition of a silico-alkaline flux, containing equal parts of sand and oxide of lead, is sufficient to produce this tint from the *chang-lou* green, which is now to be described. It is therefore possible that there is no white in M. Itier's "pale-blue," and that the grayish particles are simply a plumbo-alkaline flux.

Seng-chang-lou, green of the fourth quality, to (a pound of?) which 5 oz. of *yuen-feng* are added (Ly).

This occurs in masses of a sap-green color; its coloring principle is oxide of copper; it contains no trace of oxide of chromium. Two samples in the collection of the Ecole des Mines have the same appearance. Analysis:—

Moisture,	0·67
Silica,	41·20
Oxide of lead,	49·05
Oxide of copper,	5·05
Alumina,	0·17
Oxide of iron,	0·05
Lime,	0·12
Potash,	3·96
Soda,	0·60

Seng-chang-kou-lou, green of the fifth quality, to a pound of which 5 oz. of *yuen-feng* are to be added (Ly).

The rough color is a mixture of fused vitreous fragments of two shades. Of these some are green, and resemble the green *seng-chang-lou*; the others yellow, and similar to the *chang-hoang*, which will be presently mentioned. The samples in M. Itier's collection and in that of the Ecole des Mines confirm this view of the composition of this color. By separating the fragments and weighing them separately, the authors found that the proportions were, of—

Chang-lou (green)	60
Chang-hoang (yellow)	40

The green fragments, analyzed separately, gave the same composition as the *chang-lou*:—

Humidity,	0·51
Silica,	41.50
Oxide of lead,	48·40
Oxide of copper,	5·50
Alumina,	0·40
Oxide of iron,	0·07
Lime,	0·18
Potash and soda,	3·44

The analysis of the separated yellow fragments gave 40 per cent. of silica; they were colored with antimony.

Eul-lou, second green (ticketed *vert jaune clair*).—This is a very fine powder, of a pale greenish-yellow color; on immersion in water, it is seen to consist of a mixture of green and yellow particles. It effervesces slightly with dilute nitric acid, the acid taking up lead.

Fen-lou, green powder (ticketed *vert jaunâtre clair*).—It is an intimate mixture of three different substances (green, yellow and white), which can only be distinguished well by immersing the powder in water. The color of the mixture is a pale yellowish green; it effervesces with dilute nitric acid, and the acid afterwards contains lead.

The analysis of these two greens gave the following results:—

	Eul-lou.	Fen-lou.
Loss by heat,	2.60	2·50
Silica with traces of stannic acid,	33·30	36·80
Oxide of lead,	53·14	51·04
Oxide of copper,	0·60	0·51
Oxide of antimony,	3·00	2·01
Alumina and oxide of iron,	1·06	1·12
Lime,	2·11	1·74
Magnesia,	0·03	0·05
Arsenic acid,		0·50
Alkalies and loss,	4·16	4·23

The authors remarked that there is a great uniformity in the composition of the flux in all these green colors; the following differs from them in this respect, but the difference is diminished by the addition of a large quantity of oxide of lead.

Seng-ti-lou, rough green of the sixth quality.—For use it must be pounded and mixed with *yuen-feng*, 19 oz. of the latter to a pound of color (Ly).

According to the catalogue of the Ecole des Mines, this green is pro-

cured from the district *Fou-leang-hien.* It is a very complex substance, formed of fragments of a sap green color, like *chang-lou*, and of a granular brownish powder with a tinge of violet. These substances are in the proportion of 75 parts of the green fragments to 25 of the powder. The green fragments present the reactions of the *Seng-chang-lou*; like it, they contain 41 per cent. of silica.

The brownish powder my be separated into three substances by washing in water:—

1. A green powder, which is certainly the result of the friction of the fragments of *chang-lou.*
2. A grayish sand-like powder, with the properties of *sy-chi-mo.*
3. A violet powder containing copper.

Nitric acid dissolves the brown powder with evolution of nitrous vapors, leaving the gray and green powders untouched. The solution contains copper. Dilute muriatic acid acts in the same manner, but when concentrated it also dissolves a little oxide of lead. Analysis:—

Silica,	67·9
Oxide of lead,	2·0
Copper,	20·7
Oxide of iron,	1·0
Lime,	0·3
Alumina,	0·5
Oxygen, potash, and loss,	7·6

The copper is here regarded as metal, as it exists in the substance in two states of oxidation. This composition fully accounts for the large addition of white lead indicated by Father Ly.

When triturated, this color forms a dull violet brown powder, but after baking it gives a bright green, similar to that furnished directly by the *chang-lou.*

In M. Itier's collection there is a similar color, which he calls Scheele's green.

Ta-lou, grass green (ticketed *vert de Scheele*).—It is a nankeen-colored powder, united into irregular fragments, and giving a green tint by the action of fire. It effervesces with dilute nitric acid, and the solution contains lead. Nitric acid does not attack it when heated; the nankeen color remains, which renders it probable that the copper is in the state of protoxide. Muriatic and nitro-muriatic acids attack it completely; a mixture of oxide of lead and deutoxide of copper is dissolved. Analysis:—

Loss by heat,	4·30
Silica,	35·20
Oxide of lead,	51·05
Oxide of copper,	3·98
Alumina and oxide of copper,	1·40
Lime,	1·00
Magnesia,	traces
Stannic acid,	traces
Alkali and loss,	3·07

All these greens consist therefore of a glassy flux, in which a few parts of oxide of copper are dissolved. The authors remark also that their direct experiments show that oxide of lead increases the greenness of the tint obtained from the oxide of copper. Soda produces a glass of which the tint is less blue than that obtained with an equal quantity of potash under similar circumstances.

5. *Yellows.*

The Chinese produce yellow on porcelain by means of antimony. There are, in the collections examined by the authors, several yellows, both in the rough and prepared state. They are called *thsing-hoang*, *chang-hoang*, *yan-hoang* and *hoang-se.*

The authors have analyzed the rough *chang-hoang* in the collection of Sevres, and the *hoang-se* brought by M. Itier. The authors offered so close a resemblance to these, that it was thought not worth while to analyze them.

Seng-chang-hoang, or yellow, to a pound of which 5 oz. of *yuen-feng* are added (Ly).—This is in bright yellow, fused, puffy fragments, with a slight greenish tinge. When reduced to powder, it is attacked by muriatic acid. Analysis:—

Humidity,	1·13
Silica,	40·47
Oxide of lead,	51·53
Oxide of copper,	0·35
Alumina and oxide of iron,	traces
Lime,	0·17
Antimonic acid,	3·60
Potash,	3·39
Soda,	0·71

Hoang-se yellow (ticketed *jaune*).—This is a pale yellow powder, which appears to be homogeneous even under water; it effervesces very slightly with dilute nitric acid, and the solution contains lead. The analysis shows that it is the same yellow as the *chang-hoang* of Father Ly, with the addition of a small quantity of the *yuen-feng*, which, he states, should be added to that color to render it fit for use. Analysis:—

Loss by heat,	2·10
Silica with traces of oxide of tin,	33·00
Oxide of lead	54·14
Oxide of copper,	0·30
Antimonic acid,	3·47
Alumina and oxide of iron,	0·80
Lime,	0·70
Magnesia,	0·60
Alkalies and loss,	5·09

All the Chinese yellows have therefore the same flux. To reproduce them, the following mixture must be slightly melted together:—

Orange minium,	8
Sand,	4
Antimony,	4

This gives a fusible Naples-yellow.

The following mixture is then thoroughly melted into a transparent glass:—

Orange minium,	44
Sand,	36
Fused carbonate of soda,	7

The two substances are then triturated together, and yellow will be obtained having the same composition and properties as the *chang-hoang*.

To be Continued.

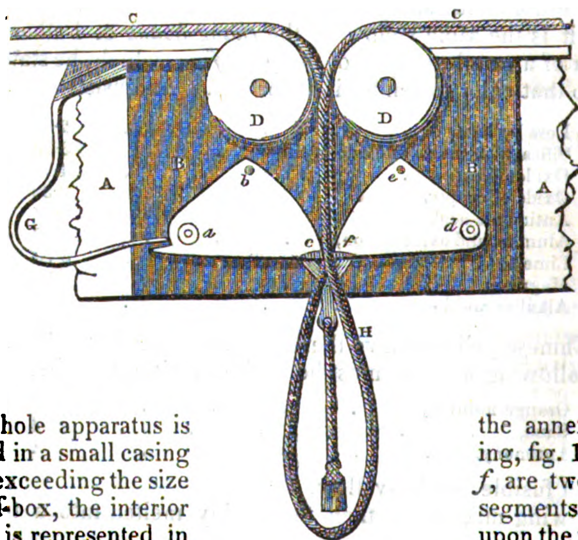
*Improved Support for Venetian Blinds.**

A model of a small apparatus recently patented by Mr. Brae, of Leeds, was exhibited. Its immediate destination is a self-retaining support for venetian blinds; in which the inconvenience daily endured by the present mode of fastening down the lifting cords by twisting them round a couple of hooks in the window frame, must be too present to every one's domestic experience to need description.

Contrivances for the purpose of self-supporting venetian blinds are, it is true, already in partial use; but they are subject to many objections, one only of which need be alluded to—so weighty, that of itself it recommends any improvement that may obviate it; this is the necessity for the blind being originally designed and manufactured for the express apparatus intended to be applied to it, thereby excluding from help the many thousands of existing blinds constructed upon the old principle.

A distinguishing advantage, therefore, possessed by the apparatus exhibited, is the facility it presents for being attached to any blind, old or new; but there is another peculiarity, which may or may not be considered an advantage, which is the option of placing the raising cords so as to hang down in the centre of the window, instead of at the side, and thereby removing the operation to a more convenient and accessible situation.

Fig. 1.



The whole apparatus is contained in a small casing scarcely exceeding the size of a snuff-box, the interior of which is represented in the annexed drawing, fig. 1; *a b c*, *d e f*, are two eccentric segments revolving upon the pivots, *a d*.

The radii, *a b*, *d e*, are shorter than the radii, *a c*, *d f;* consequently, when the segments are in the position represented in the drawing, their circumferential edges are nearly in contact; but when they are drawn down so as to cause the shorter radii to approach, a considerable space or opening will then exist between them. Each segment is provided with a similar segment of cogged teeth, only that these are not eccentric, but are portions of true circles, so that when together, the teeth of one

* From the Journal of the Society of Arts, London, No. 15.

working between those of the other, the two segments are always constrained to move simultaneously; for the sake of clearness, these cogged portions are omitted in the figure.

Two straps are seen beneath the segments uniting in one shorter strap, from which the middle tasseled cord depends. These straps pass up behind the segments, and pulling from the points *b* and *e* cause the segments to descend and increase the opening between them. Finally, the segments are impressed with a constant tendency to close upon any intervening substance by the action of the spring G.

D D are leading pulleys, over which the ends of double cord H are led in the usual way, down through the blades of the blind, so as to gather it up.

It will be apparent from this description, that when the double cord H is pulled downwards the segments will at once give way and admit of the blind being pulled up, but it cannot recede, because the tendency is then reversed, and the greater the pull the greater the resistance to it; therefore the blind remains at any altitude; and when it becomes desirable to lower it, the tasseled cord pulled, by which the segments are again reversed, the resistance to the descent removed, and the extent of the descent regulated by the principal cords in the usual way. The small box containing the apparatus may be so constructed as either to be screwed on to the exterior of the top rail of the blind, or it may, as in the model, be bodily let into its substance.

Mr. Brae believes that the principle shown in this little invention may be usefully applied in many other cases, and especially in certain of the numerous operations on board ship, in which the power of tightening and firmly holding a rope or cord is required.

Fig. 2.

Fig. 2 represents the construction of the segments of the detainer in its application to lowering boats from the davits, freeing life-buoys, and other purposes on board ship,—when, instead of a string for the back, and a spring to incline the longer radii to be opposed, a lever and counterpoise are used.—*Proc. Soc. Arts, London.*

Specification of a Patent granted to LAZARE FRANCOIS VAUDELIN, *for Improvements in obtaining Wool, Silk, and Cotton from old fabrics, in a condition to be again used.*—(Sealed 30th June, 1852.)*

The object of this invention is to obtain wool, silk, and cotton from old fabrics, in such a condition as to admit of the same being again spun and used in the manufacture of other fabrics; and it is proposed to

*From the London Journal of Arts and Sciences, March, 1853.

effect this by passing the old fabrics, whilst immersed in water, between a rotating cylinder and a flat plate, or other surface, armed with teeth or points, by which the fabric is torn to pieces, and the fibres brought into a suitable state to be again manufactured into fabrics. It has hitherto been the practice to tear old fabrics to pieces, for the above purpose, in a dry state; but the fibres are not so readily separated, and are more injured and broken than when working according to this invention, with the fabrics constantly immersed in water,—whereby, also, the fibres are thoroughly cleansed.

Fig. 1.

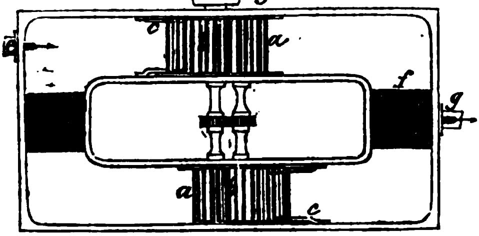
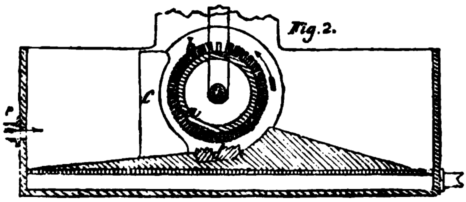


Fig. 2.



The old fabrics having been washed, if they require it, are cut into pieces, say from two to eight inches square, and then introduced into a machine similar to those employed in the preparation of rags for making paper, except that the patentee prefers to construct it with two beating-wheels. This machine is shown in figs. 1 and 2—fig. 1, being a plan view, and fig. 2, a vertical section thereof. *a*,*a*, are the beaters or beating-wheels, in the periphery of which numerous straight metal blades *b*, with plain edges, are fixed, at equal distances apart, and parallel to the axis of the beater. In some cases, however, as when tearing silk, cotton, and mixed rags, the patentee uses blades with notched edges; and then he places behind each beating-wheel a comb or bar, with points to hook off the silk or cotton, so as to prevent any clogging of the machine. The beating-wheels are furnished with covers (not shown), to prevent the splashing over of the water; and guards *c*, are provided, to prevent the fibrous materials passing between the flanches of the beating-wheels and the sides of the machine. Beneath each wheel there is fixed a metal plate *d*, covered with points or teeth, which serve, with the blades *b*, of the rotating-beaters, to tear and separate the fibres of the rags that are drawn between them by the rotation of the beaters. Water constantly flows into the cistern of the machine through the pipe *e*, and continually passes off through the perforated surfaces *f*, and pipe *g*. When silk goods are being operated upon, the work goes on better if the water is used at a tempera-

ture of about 90° Fahr., and a small quantity of soft soap may be introduced into the water with advantage. The axes of the beating-wheels can be raised and lowered by means of screws (not shown), as may be required during the operation of separating the fibres.

The patentee states, that he does not confine himself to the above details, as the same may be varied, so long as the peculiar character of his invention—that of treating old fabrics in water, so as to separate the fibres into a state to be again used with other fibres in the manufacture of fabrics, by spinning and weaving—be retained.

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*Process for Electro-Plating China Ware.**

A specimen of china, coated with silver, was exhibited. Hitherto the art of electro-plating has been chiefly confined to metallic bodies, owing to their affinity for such deposits. The patent recently taken out by Mr. Ridgway, of the Staffordshire Potteries, extends it to Parian figures, ornamental china and glass, and to every description of Ceramic ware.

The advantages are manifold, when it is considered that this art may be applied to the most beautiful models, so as to retain all their sharpness and effect, without the cost of dies and other heavy charges to which the metallic department is subject, thereby cheapening the article; while, by means of chasing and embossing, richness is given.

The mode of effecting the electro-deposit is as follows:—In the first place, the articles are steeped in strong alcohol, or certain gelatinous solutions, and when nearly dry immersed in nitrate of silver or otherwise, so as to prepare them for receiving the deposit of copper. This done, they are plunged into cold water, and carefully dried in a suitable kiln, after which they are placed in sawdust for twenty-four hours to prevent oxidation.

The next operation is to remove any roughness on the surface which the articles may have contracted. This is done by means of sand paper or silver sand, and brushing with a scratch-brush till they are made perfectly smooth, care being taken to remove any greasy matter from the surface.

The copper and silver have now to form one alloy, so as to unite them firmly together. For this, a film of quicksilver is employed, dissolved in nitric acid. This is set aside to crystallize, and the crystals are dissolved to form the desired solution; the articles are then dipped therein, passed through water, and introduced into the vat containing the silver solution.

The silver solution consists of metallic silver dissolved in nitric acid diluted with water, with the addition of certain cyanides, till a given result is obtained. This is followed by a repetition of the copper process only with the solution, and the articles in due time appear in their silver garb, ready to receive the chasing.

Gold is prepared by being dissolved in nitro-muriatic acid. This chloride is digested with calcined magnesia, and the whole precipitated into an oxide. The oxide, boiled in strong nitric acid, dissolves the magnesia, and when washed forms a cyanide of gold and potassium.

* From the Journal of the Society of Arts, London, No. 15.

The films of gold are deposited in the vessels by means of voltaic electricity, a process requiring careful observation, both to insure an adequate coating and the proper color; if defective, it will have to be repeated.

The time of exposure to the heat depends upon its intensity, and the color desired to be produced; these must be the fruits of experience, and will not fail to be acquired by practice.

The finishing process is the burnishing, which is the same as with the silver, and requires no further illustration.

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*Manufacture of Lucifer Matches.**

The preparation of lucifer matches has been found to be productive of a painful disease in the workmen employed. The vapor evolved from the phosphorus acts upon the teeth and jaw-bones, in many cases producing caries; but a new species of phosphorus, called amorphous phosphorus, has lately been discovered. The nature of the chemical difference, if any, between this phosphorus and common phosphorus is not at all understood. The amorphous phosphorus is prepared by melting common phosphorus in a peculiarly-constructed retort, and keeping it for some time at a temperature of 500° Fah. By this treatment the phosphorus becomes a soft, opake mass, easily pulverized, and so incombustible, that it may be handled, or even swallowed, with impunity. This species of phosphorus is found to be suitable for matches, and does not give out injurious fumes. We extract the following from Tomlinson's *Cyclopædia of Useful Arts*:—

"The wood employed in the manufacture of lucifers is the best pine plank, as free from knots as it can be procured. Each plank is cut across the fibres, by means of a circular saw, into 28 or 30 blocks, each measuring 11 inches long, 4½ wide, and 3 inches thick. These blocks are cut up into splints by a machine of simple but ingenious construction, which we will endeavor to explain in a few words. To the extremity of the horizontal arm of a crank is attached a frame, which reciprocates to and fro with the motion of the crank through a space of about 4 inches. In this frame are fixed in a line some 30 or 40 lancets with the points projecting upwards, and separated from each other by pieces of brass. The block of wood to be cut is inserted by the small end between uprights, and a lever placed upon it forces it down to a position such, that, as the lancet-points advance, the end of the wooden block is scored or cut in the direction of or parallel with the fibres, with as many lines as there are lancets. As the lancets are withdrawn by the motion of the crank, a scythe blade moving in a horizontal plane swings round, and cuts off the end of the block to the depth of the scores made by the lancets. The pieces thus cut off will evidently be four-sided splints, square in section, supposing, as is the case, that the lancets are equidistant, and that the horizontal knife cuts exactly to the depth of the lancet scores. When the horizontal knife swings back, the block from which one layer of splints has thus been removed descends through a space equal to the depth of

* From the London Artizan for February, 1853.

the section, the lancet-points again advance and recede, and the knife again does its work. In this way the cutting is carried on with such rapidity, that from 12 to 16 planks, each 12 feet long, 11 inches wide, and 3 inches thick, can be cut up into splints in a day of ten hours. Now, supposing 14 planks are thus cut up, and that each plank produces 30 blocks, we thus get $14 \times 30 = 420$ blocks. Each block affords about 100 slices, which are cut off by the horizontal knife; but as each slice, before being cut off, has been scored by 31 lancet-points, we thus get $420 \times 100 \times 31 = 1{,}302{,}000$ splints; and as each splint makes two matches, we thus have 2,604,000 single match-splints per day.

Fig. 1.

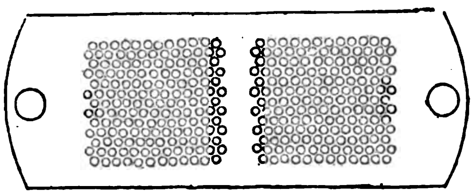


Fig. 2.

"When a circular, instead of a square section is required, the wood is cut into splints by means of a perforated metal plate, the perforations being so shaped as to cause the block of wood, when pressed against its face, to be properly divided. Fig. 1 shows the face of the plate, and fig. 2 a vertical section of the same. The perforations are cylindrical throughout, except at their openings on the face, where they are slightly countersunk, for the purpose of presenting sharp-cutting edges to the wood, and affording a more easy entrance. The perforations are made as close together as possible, that all the wood may be used, only sufficient metal being left to afford the necessary strength for cutting. The plate has a steel face and a bell-metal back; it is 3 inches wide, 6 inches long, and about 1 inch thick. The back is fixed against a firm resisting block or bearing, with an aperture equal to the area of the perforations of the plate. The piece of wood being placed on end in the direction of the fibres, the plate is forced down upon it by means of a plunger or lever, when the splints appear at the back of the plate, whence they are removed before another block is applied. This plan was patented by Mr. Partridge in 1842.

We now return to the square match. As the splints fall off the end of the block by the action of the horizontal knife, they pass down a shoot immediately under the block into a room below, where they are tied up into bundles, each containing half a gross. For this purpose, a cradle or measure is formed, consisting of a section of a hollow cylinder, of the capacity of half a gross of splints of the proper size, either for the *large* splints, or the second size, called *minikins*, these being the only two sizes made at this factory. The man begins by throwing a piece of string

across the cradle, then taking up a number of splints from the confused heap, he ranges them in parallel order by a dexterous system of tossing, knocking, and jerking. Having filled his measure, he catches the two ends of the string, ties up the bundle, throws it aside, and then proceeds to make another, the work being done with the rapidity and precision which practice alone can give. These bundles are piled up on the racks of a hot-room or drying stove, and left for some hours, until moisture is expelled.

"The next process is the *sulphuring*. The sulphur is melted in an iron pot over a stove, and, when sufficiently fluid, the two ends of the bundles are successively dipped, the bundle being shaken after each dipping, in order to get rid of superfluous sulphur. When the sulphur is dry, a second string is tied round each bundle, so that, when divided by the circular saw, each bundle of double matches may make two bundles of single matches. Some of the matches, however, are not divided until after having been tipped with the phosphorus composition; but this is merely a matter of convenience to the makers.

"The matches are now ready for dipping in the phosphorus composition. We are not informed as to the precise ingredients of the composition, or the method of mixing. Each manufacturer professes to have his own recipe, which he regards as the best, and therefore keeps secret. The ingredients are, however, well known to chemists; the principal one is phosphorus, which is made into an emulsion with glue or gum arabic, the former being preferable, since gum absorbs moisture. Some makers use nitre, others fine sand; and all use coloring matter, which may be red ochre, red lead, smalt, or artificial ultramarine.

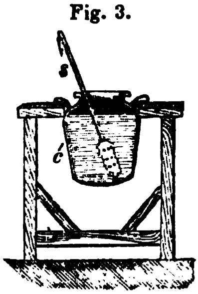
"The following proportions have been found to answer:—

	Glue paste.	Gum paste.
Phosphorus,	2·5	2·5
Glue,	2	Gum 2·5
Water,	4·5	3
Fine sand,	2	2
Red ochre,	0·5	0·5
Vermillion,	0·1	0·1

"Instead of the last two coloring substances, 0·05 of Prussian blue may be used.

"When glue is used, it is of very inferior quality. It is broken into fragments, and soaked for a few hours in cold water; then dissolved in a large glue-pot, or copper, heated by a water bath. When it is perfectly fluid, and at the temperature of 212°, the copper is withdrawn, and placed in the circular opening of the frame (fig. 3). The phosphorus is then added by degrees; it melts immediately, and subsides, but is kept in agitation by means of the wooden stirrer, *s*, which is furnished at the lower part with projecting pegs, the object being, as the glue cools, to obtain an emulsion of phosphorus in a minutely divided state. The sand and coloring matters are added during the stirring. The paste is kept at the temperature of about 98°, sufficient to retain it in a fluid state by placing the vessel, c, in a water bath."

Fig. 3.



FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, July 21, 1853.

John E. Addicks, Esq., President, P. T., in the chair.

Edmund Draper, Esq., Recording Secretary, P. T.

The minutes of the last meeting were read and approved.

A letter was read from Dr. C. M. Wetherill, accompanying his donation of Specimens of Iron and Iron Ores of the State of Pennsylvania.

Donations to the Library were received from The Statistical Society and The Society of Arts, London; The Smithsonian Institution, Washington, D. C.; The Maryland Institute, Baltimore, Md.; Wm. J. Lewis, Esq., California; A. J. Brasier, Esq., and Prof. John F. Frazer, Philadeldelphia; and the Medical Superintendents of American Institutes for the Insane.

Donations to the Cabinets—From Dr. Charles M. Wetherill, a Collection of Iron and Iron Ores of the State of Pennsylvania, consisting of upwards of 500 specimens, arranged and catalogued.

The Periodicals received in exchange for the Journal of the Institute were laid on the table.

The Treasurer's statement for June was read.

The Board of Managers and Standing Committees reported their minutes.

The Chairman of the Committee on Exhibitions made a verbal report of their proceedings.

New candidates for membership in the Institute (4) were proposed, and the candidates (3) proposed at the last meeting were duly elected.

On motion, a special vote of thanks was presented to Dr. C. M. Wetherill, for his valuable donation of Specimens of Iron and Iron Ores.

COMMITTEE ON SCIENCE AND THE ARTS.

Report on P. N. Receveur's Improved Rose Engine.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination, an "Improved Rose Engine," invented by Mr. P. N. Receveur, of Philadelphia, Pennsylvania—Report:

That the improvements alluded to are numerous and important, and require description in detail, as follows:

In the engine employed for rose turning the following kinds of movement are required:

1st, Revolution of the work for oval and circular cutting, with its modifications; or a reciprocating movement for right line or parallel cutting, with its modifications.

2d, Lateral motion of the work or tool, to produce the wavy lines of a pattern.

3d, End motion of the work towards or from the tool, to change the depth of cut at stated and regular distances.

4th, A change (at will) of the connexion between the work and the pattern, so that the angle between the two can be varied at any moment.

5th, A feed motion to carry the tool in a lateral direction given distances at stated periods required in producing a series of parallel or concentric cuttings.

6th, A circular motion of the tool on its bed or rest, so as to vary the angle of the cut required in engraving the edges of watch cases, &c.

The general form of the machine embodying the foregoing movements, and called the *rose engine*, may be briefly described as consisting of a hollow mandrel, on which are several narrow drums, whose peripheries are scolloped or shaped according to different designs; passing through this mandrel is another, solid, revolving in bearings or journals, and carrying in the front end chucks, &c., as in the ordinary lathe, and a cord wheel at the other end, through which rotating movement is communicated in the usual way. The hollow and solid mandrels may be connected or disengaged at will, by a pawl pressed by a spring into notches cut at regular intervals into the circumference of a plate at the back end of the guide drums. The tool is attached to a frame, which, in Mr. Receveur's improved engine, is pivoted on the table, and is free to vibrate laterally: its motion in this direction is governed by a point bearing against the guide drums; and which being fixed opposite either of these, of course moves the tool in accordance with the pattern cut upon its edge; or when withheld from contact by lightening a spring, the tool describes either a circular, oval, or straight vertical line, as the case may be.

The solid mandrel carrying the work is at liberty to move endwise, for the purpose of deepening or lightening the cut, the tool having no such motion; the shaft is pressed against a shoulder by a spring, and is reacted against this spring by a point attached to the tool frame bearing upon wavy surfaces cut on each alternate guide drum projecting from the others for the purpose. It is clear that the pattern on such guide drum will regulate the depth of the cut. The vertical motion for right line work is produced by an eccentric, and a pentagraph lever movement connected with the same eccentric enables any given pattern to be reduced in any ratio upon the work, giving rise to endless variety in the designs.

The important points of difference between the old machine and that of Mr. Receveur, are, first, that the tool frame is in his engine made movable, and the mandrel, with the work, rotates in permanent bearings; while in the old machine this condition of things is reversed, so that while in this latter the momentum of the moving parts vibrating is such as to preclude a great rapidity of motion, preserving the necessary uniformity and delicacy of cut, in the engine of Mr. Receveur, by a very simple but ingenious modification, the speed at which work can be done is limited only by the skill of the operator. 2d, That in the old engine, in order to change the angle between the work and pattern, it is necessary to stop the rotation of the mandrel, while the pawl before described as connecting the two is released, and after moving the drums to the desired point, again notched; while in Mr. Receveur's engine, a pedal arrangement is intro-

duced, whereby the aforesaid pawl is tripped by pressure of the foot; the point on the tool frame is at the same time advanced, so as to press tightly against the drums, and so keep them from turning, while the operator continues the rotation of the mandrel until it has arrived at the desired point, when the pawl is again pemitted to drop in. It should be observed that this cannot be applied to the old form of engine, on account of the vibrating pedestals supporting the drums, and the fixed tool frame, &c., which of course renders it impossible to hold the drums while rotation of the mandel is carried on. This again permits of much greater rapidity in the performance of work.

3d, In the old engine the weight of parts in the pentagraph lever arrangement is balanced by a weight suspended by a cord passing over pulleys; while in the new engine, they are connected to a spiral spring, like the main spring of a watch, placed beneath the table, and so arranged that equilibrium exists at any point in the vertical stroke. As the delicacy of the cut in right line work would be destroyed by any irregularity of motion, this must be looked upon as a decided improvement.

Besides these principal points, there are numerous details of minor importance, but all tending to facilitate the execution of designs, which it is impossible to describe in the limits of a paper like this, and which, though perhaps they are movements already known separately in the arts, are believed to have been first applied by Mr. R. to the rose engine.

The Committee feel satisfied, after a close examination of Mr. Receveur's improved engine, that the features he has introduced are highly ingenious, and promote in a marked degree the objects desired, viz: rapidity, accuracy, and variety of design; while they are believed to be original, and applied first by him to the purpose.

They therefore recommend that a Scott Legacy Medal and Premium be awarded to him for his invention.

By order of the Committee,

Wm. Hamilton, *Actuary.*

Philadelphia, June, 9th, 1853.

Report on Mr. Jacob Senneff's Metallic Heddles.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination, "Metallic Heddles," invented by Mr. Jacob Senneff, of Philadelphia, Pennsylvania—Report:

That they have given attention to Mr. Senneff's patent metallic eye harness for weaving, submitted to them for examination, and find it is made by casting soft metal nearly cylindrical in the middle and pointed at each end for the thread, with an oblong eye in the centre, through which the warp is drawn. The twine or thread is otherwise arranged as in the ordinary harness. The form of the eye, and its peculiar smoothness, afford great facilities in weaving, and at the same time presents less obstructions in passing through the warp whilst operating.

The most approved kind now in use are made of twine exclusively;

the eye is formed by using a double thread, and linking one within the other, tying a knot in each, and varnishing them highly. The double thread enlarged by the knots presents an irregular surface, and causes great friction both in the eye and outside.

It will be observed in operating with this harness, the links do not always retain their vertical position, but often double up, and overlay the warp when passing through it, causing great friction and wear of both warp and harness.

Some of the advantages of this improvement are;

1st, The abrasion being less, the threads are not weakened, and are not so frequently broken in weaving, therefore stronger cloth is produced.

2d, It allows more room between the harness for the threads of the warp to pass; this is effected by using but *one* thread instead of *two*, and there will necessarily be less abrasion of the warp.

3d, The metal eye being shortened two-thirds, diminishes the enlargement made by the eye, and the rubbing surface in the same ratio, and this also avoids friction both inside and outside the harness and warp.

4th, The warp does not require so much sizing, thus saving material and labor.

5th, The eye being *shorter*, with the same amount of motion given the old harness, it will open the warp wider and give greater space for the shuttle, and the looms may be run faster with safety, and more cloth will be woven.

6th, A finer thread may be woven, because the harness retains its vertical position whilst operating, and does not overlay and break the threads by being drawn across them; much damage is done to the threads in this way by the ordinary harness.

7th, We have evidence that in weaving colored yarns, the colors are much better defined in the cloths, because the fibres composing the threads are not so much disturbed and intermixed with each other in weaving; this is obvious in checks, and similar goods.

Although the first cost of these harness is somewhat greater than those of the old kind, yet from their greater durability and facility of working, they are considerably more economical for the manufacturer.

The Committee have seen the very ingenious machines constructed by the inventor for making these harness, and they feel confident that they can be supplied in any quantity that may be required at a reasonable price.

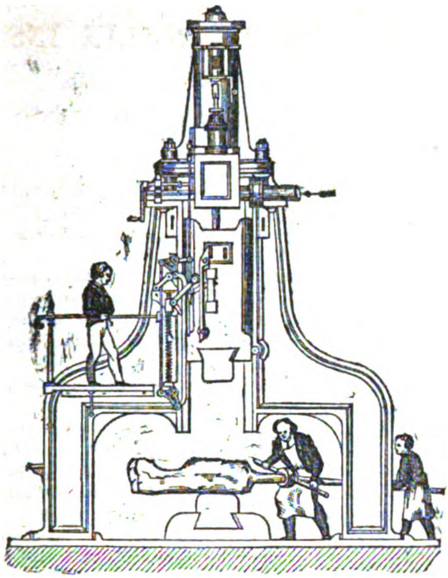
In view of the advantages secured to the public by this invention, the Committee recommend that the Scott Legacy Medal and Premium be awarded to Mr. Senneff for his invention.

By order of the Committee,

Wm. Hamilton, *Actuary.*

Philadelphia, July 14th, 1853.

TO IRON MANUFACTURERS.



NASMYTH'S
Patent Direct Action Steam Hammer.

(Merrick & Son, Assignees of the Patent for the United States.)

The undesigned call the attention of Iron Manufacturers to the Nasmyth Patent Steam Hammer, now so generally introduced into this and other countries, of which they are the assignees and sole Agents for the United States. Up to the present time there have been made by the Patentees in England, for that country and the Continent of Europe, between two hundred and fifty and three hundred hammers, for Government, Railway Companies, Copper Works, Forges, and Engineering establishments; and the undersigned have made for this country upwards of forty, varying in size from 500 lbs., falling 1½ ft., to 6 tons, falling 6 feet. They can, therefore, confidently urge its merits upon the trade, and are provided with certificates in its favor from many parties, (who have one or more in use,) which will be shown upon application.

The advantages of this Hammer over all other forms are as follows:—

1st, The Ram falling vertically, the surfaces of the bitts upon it and the anvil are always parallel, giving facilities for flattening a ball or faggot of any thickness; and the fall being far greater than that of any helve hammer, a much thicker mass may be placed under, without choking it.

2d, The intensity of the blow may be modified instantly by the attendant, so as to suit the work; and the Ram may in like manner be *arrested in its descent* at any point, so that it is more completely under control than any other form known.

3d, It may be adapted to any description of work, whether for hammering blooms, making heavy forgings, or the ordinary light forgings for machine shops; for beating copper, or crushing stone, &c., &c., The form of the side frames can be altered to suit circumstances, so as to allow free access on all sides.

4th, It requires no Steam Engine to work it; hence the friction and other losses incident to the ordinary hammer are materially reduced. In Forges the waste heat from the furnaces gives ample steam to work it. Every Hammer is provided with self-acting and hand gearing.

For terms and other particulars, apply to

MERRICK & SON,

Southwark Foundry, Philadelphia.

JOURNAL

OF

THE FRANKLIN INSTITUTE

OF THE STATE OF PENNSYLVANIA

FOR THE

PROMOTION OF THE MECHANIC ARTS.

SEPTEMBER, 1853.

CIVIL ENGINEERING.

On Various Irregular Motions of Locomotive Engines. By D. K. Clark, Civ. Eng.*

In these days of railway casualties, too frequently, we fear, improperly called *accidents*, no apology is necessary for introducing the following observations from Clark's *Railway Machinery*—reviewed in last month's *Artizan;* and it is impossible to overrate their importance. As such, we invite to them the especial attention of our readers and contributors.

Of the Pitching Movement.—The resistance to pitching, and thereby the stability, is promoted by shifting the driving axle backwards, towards the fire box, principally because it increases the mass of the machine in advance of the axle, or that which is submitted to the oblique action of the connecting rod; the removal of the axle also, in so far as it lengthens the connecting rod, reduces the obliquity which is the source of the disturbance. In Crampton's engine, having the axle behind the fire box, the whole mass lies forward; while, at the same time, the guide bars, where the action takes place, are in the neighborhood of the centre of gravity; thus, the oblique action is entirely controlled, and the pitching is extinguished.

Above all, the number and position of the points of support, mostly control the pitching. The springs, also, particularly the fore and hind springs, should be as stiff as is consistent with the preservation of the frame and mechanism, to neutralize the oscillations which may arise from

* From the London Artizan, February, 1853.

imperfections of the permanent way—such as loose sleepers, open joints, or want of correct gauge; for if these oscillations should coincide with the action on the guide bars, they increase the straining of the machine, and the liability of the leading wheels to mount the rails. Susceptible springs, also, for the same reason, increase the danger from accidental obstructions.

Vertical Action by the Centrifugal Force of the Revolving Weight.—This action may be nearly neutralized by the application of suitable counter-weights. This question, however, belongs to the more general question of balancing all the revolving and reciprocating masses.

The reduction of adhesion, by vertical action, explains the occasional slipping of the driving wheels at high speeds. It explains also the extra wear of driving wheel tyres, when very much out of balance, next the crank pin, where the pressure on the rail is greatest, producing "flat places," and in consequence a vertical jolting of the engine while in motion.

Longitudinal Fore and Aft Motion.—It was found that in the sample engine a joint longitudinal action on the driving axle of above six tons, or three tons for each cylinder, was incurred at certain points of the stroke, at a speed of fifty miles, by the crank and the other moving masses. Now, the whole pressure of 100 lbs. steam on a fifteen-inch piston does not exceed eight tons; thus, the inertia of the mechanism alternately adds and subtracts three-eighths or 40 per cent. of this pressure, reducing the useful pressure to five tons, or 60 per cent., when the crank is at 45° during the first half-stroke; and raising it to eleven tons, or 140 per cent., at 135° in the second half-stroke. This example shows how very greatly the inertia of the machinery may affect the useful work of the engine. And, so long as the whole effective pressure in the cylinder exceeds this inertia, the coupling bars between engine and tender remain taut on their pins, though subject to oscillation with the coupling spring. But when the steam pressure is less, or altogether removed, with a small train, or going down an incline, they play fast and loose, owing to the fore and aft action, by which the machine is alternately thrown forward and backward on the tender. This explains the extra racket and jarring which takes place between an unbalanced engine and its tender immediately after shutting off the steam, in approaching stations, particularly where the nature of the coupling gear permits of some play. The shocks arising from these fore and aft vibrations are destructive to the coupling links and bolts, to the framing which carries them, and to the general connexion of the whole machine, especially at the axle boxes and guard plates. And the greater the play of the parts of the engine, the more injurious is this action.

To neutralize or soften the longitudinal action, it is usual to employ a traction spring under the foot plate of the engine or tender, to receive the shocks; it is either coupled to a draw bar of a fixed length, under permanent tension between the draw bolts, or adjustable by a double screw, right and left hand; in either case, buffing blocks of wood are fixed at some distance apart laterally, upon the front beam of the tender frame, to bear upon the engine frame, as fulcrums for the action of the spring. With the object of softening the action still further, the buffing

blocks are in some cases made elastic within a limited compass, by the use of india rubber springs. Counterweights, also, are applied to the wheels, and are efficient so far as they go; but they are, for the most part, much too light, as they are estimated for the revolving weight only.

Of the Sinuous Movement.—As this affection of the motion of the engine implies the lateral play of the fore and hind wheels upon the rails, the friction of the tyres upon the rails, due to this lateral displacement, is opposed to the motion, and its tendency is therefore to steady the engine. Accordingly, in practice, at the lower speeds, and when the intensity of the disturbing forces is low, the machine, though unbalanced, runs sufficiently steady in respect of sinuous motion. At speeds above thirty miles, the greater disturbing forces overcome the resistance to their development, and the sinuous motion becomes more violent, the higher the speed. Even in Crampton's ordinary engines, sinuous action becomes sensible when the speed reaches sixty miles.

Many things go to increase the sinuous motion to which the engines may be predisposed by want of balance; such as a want of parallelism of the axles, unequal diameters of the wheels, the wear of ruts or hollows in the tyres, the wear of the axle boxes and bushes, which gives rise to longitudinal and transverse play at the axle guards and on the journals, the outline of the rails, and sometimes a want of accuracy in the adjustment of the draw bars. When the axles are not parallel, but incline towards each other on one side of the engine, their disposition is to roll the engine forward in a curved path, and always towards the same side, causing perpetual collisions between the flanches and the rail. This oblique tendency is injurious enough on the straight parts of the line, but it is much worse on curves which diverge towards the other side, and increases the liability to get off the rails. The same tendency is caused by wheels of unequal diameter on the same axle. Again, when the tyre wears hollow, the outer part, originally less, is left larger in diameter than the middle of the breadth of tyre. This state of wear reverses the action intended in coning the tyres, as the greatest diameter, instead of being next the flanch, is shifted to the outside; and, whereas a properly coned tyre constantly seeks to maintain the wheels in the centre of the track, a hollow tyre leads the engine continually astray, and subjects it to constant concussions against the rail. Play of the axles and axle boxes, by giving scope for irregular action, converts what without play would be a simple strain or flexure of the guards, into shocks upon the journals and wheels laterally. And it must be noted that though some degree of flexibility in the frame may be beneficial for the easy working and adjustment of the machine to the rails, when in good order, it is a very dangerous accompaniment for a slack and unsteady engine. That these varieties of tear and wear are all productive of unsteadiness, is proved by the superior stability of a new engine, with all its parts well up to their gauges, and all its bearings taut.

The means employed to reduce the fore and aft movement operate also in reducing sinuous movement. A great extension of the wheel base has also been employed with benefit, because it reduces the angular play of the wheels between the rails, and increases the command of the leading wheels in controlling erratic movements, by their frictional resistance

transversely on the rails. In Crampton's engines, which carry out this principle to its limits, and impose the greatest loads upon the extreme wheels, the mass of matter in advance of the driving axle still further promotes the stability; and these engines, though they may not be balanced artificially, are practically steady at sixty miles per hour. But the great spread of wheels, though beneficial on straight lines, is prejudicial on the curves, and particularly in passing into sidings; for it is plain that the farther apart the extreme axles, the greater is the angle at which the leading wheel flanch meets the outer rail on curves, and the more severe is the labor of guiding the engine.

The springs between engine and tender, though useful for reducing the fore and aft motion, have been introduced chiefly to meet the horizontal oscillation. But it is clear that, in so far as they, and all similar appliances, reduce this movement, they tend to consolidate the engine and tender, and injuriously to increase the length of fixed wheel base. A draw spring between engine and tender is no doubt a good thing; but it should be employed rather as a mere carriage spring, to soften the irregular motions of the tender itself. The wheel bases of locomotives are abundantly long enough for the fair purposes of a carriage, and it is mechanically unsound in principle, and inexpedient in practice, to divert them from their legitimate function; for, as M. le Chatelier most justly observes, "it is only in a direct manner, by attacking and destroying the cause itself, that we should seek to extinguish the lateral oscillation of locomotives."

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*Experiments on the Blast and Exhaust Pressures in Locomotives.**

Of the Influence of Exhaust Pressure on Blast Pressure.—The exhaust pressure at the point of release, as it is a measure of the quantity and force of steam discharged, is the most proper datum for comparison with blast pressure. It has been found that the back exhaust pressure in the cylinder varies simply as the pressure at the release point. It is thus probable that the blast pressure (at a greater distance) should vary in the same ratio. The mean results of numerous observations confirm this inference, and, as a sample of the evidence, we may quote the following from C. R., No. 124, all taken in the course of a single trip:

TABLE No. XLI.—*Relation of Blast Pressure to Release Pressure.*—C. R., No. 124—1st Notch.

Speeds.	Exhaust Pressure at release.	Blast pressure in inches of mercury.
m. p. h.	lbs.	ins.
20	15	5½
19	23½	8¼
18	28	9
9	37	12¼

Each of these is a mean of two observations at nearly equal speeds and exhaust pressures, and it is plain that the blast pressure varies virtually as the pressure of exhaust at the release point.

* From the London Artizan for February, 1853.

Of the Influence of Speed on Blast Pressure.—In so far as the elevation of the mercury is due to the intermittent impulses of the blast, it may be conceived to be directly as the frequency of these impulses, or as the speed simply. Much of it is dependent also on the continuous expulsion of the residuary steam, and in so far it must vary as the square of the speed. The superior influence of the latter appears from the following observations selected to illustrate the influence of speed. The last column contains the blast pressures reduced for a mean uniform exhaust pressure at release, the reductions being made according to the law that the blast pressure is directly as the release pressure.

TABLE No. XLII.—*Relation of Blast Pressure to Speed.*

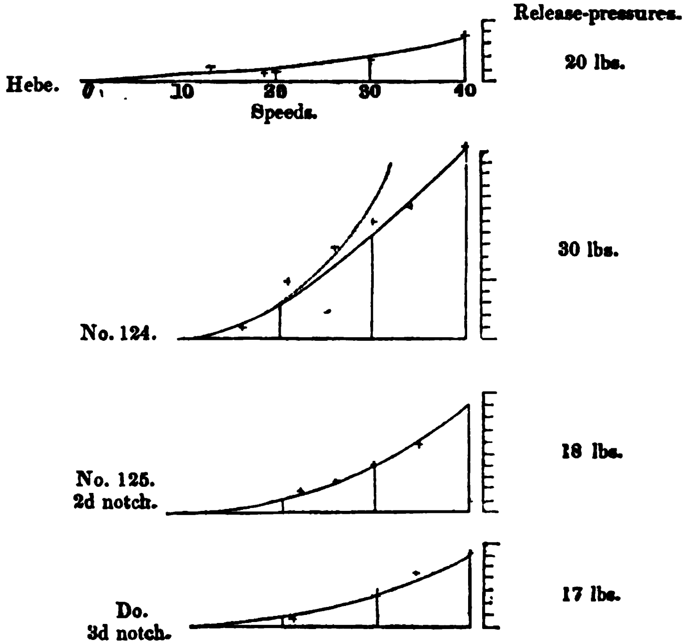
Nos. of Observations.	Mean speeds of engine.	Mean release pressures.	Mean blast pressures.	Reduced blast pressures.	
	m. p. h.	lbs.	lbs.	ins.	
	E. & G. R. Hebe.—4th Notch.				
1	13	11	½	⅞	for 20 lbs. release.
2—5	17	26	¾	⅝	
6—13	21	29	1¼	⅞	
14—17	30	21	1¾	1¾	
18	40	11	2	3⅝	
	C. R., No. 124.—1st Notch.				
1	6	23	¾	1	for 30 lbs. release.
2—3	11	38	5¾	4½	
4—6	16	39	11	8¼	
7—14	20	25	8½	10	
15—19	24	30	11	11	
20—23	30	17	9¼	16¼	
	C. R., No. 125.—2d Notch.				
1—2	12	20	2	1¾	for 18 lbs. release.
3—5	16	19	2	2⅜	
6—9	20	19	4	4	
10—11	25	15	4¾	5¾	
	Do. 3d Notch.				
1	11	13	½	⅝	for 17 lbs. release.
2—4	20	21	3¼	2½	
5—11	24	15	4	4½	
12—14	30	19	7	6¼	
	Do. 4th Notch.				
1	16	12	1	1⅛	for 14 lbs. release.
2—3	20	16	1¼	1	
4—6	27	13	1½	1½	
7	33	13	1	1	

In each series of pressures in the last column, it is clear that, except in the last case, the blast pressures rise very rapidly with the speeds. Throwing them into curves, in the usual way, we obtain the following results, (fig. 1,) for the respective examples noted. The last case, of No. 125, 4th notch, has been omitted, as the data are insufficiently distinct. The base lines contain the speed in miles per hour, and the perpendiculars express the blast pressures in inches of mercury. All the curves but the second follow the law of the variation of blast pressure as the square of the speed; the dot curve in the second case is constructed on this law,

but it is plain that the true curve is flatter, and indicates a law of variation inferior to the square of the speed, but superior to the speed simply. The other cases so distinctly harmonize with the law, that it may be inferred generally that the mean pressure at the blast orifice varies as the square of the speed, though occasionally (in exposed cylinders), the variation does not proceed so rapidly; but, in all cases, in a much higher ratio than the speed simply.

Comparative Value of Blast Pressure and the Pressure of Exhaust.—To compare these pressures directly, the former, indicated in inches of mercury, must be reduced to pounds; and as 30 inches of mercury balance 14·7 lbs. pressure per inch, we shall adopt 1 lb. of pressure as an equivalent for 2 inches of mercury.

Fig. 1.

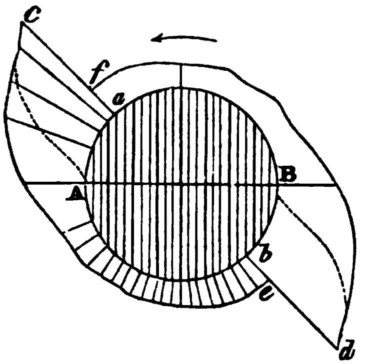


Curves showing relation of blast pressure to speed.

The mean blast pressure as measured by the gauge, results from the average indicated pressure of exhaust in the cylinders, exerted from the release point onwards to the point of compression. In each cylinder, usually there is a perpetual exhaust, as the valve no sooner closes the exhaust for one end of the cylinder than it opens it for the other. There are, therefore, two constant exhausts in operation, yielding jointly the blast pressure observed. Each exhaust is derived from a series of explosions, and is therefore variable in intensity. The variation in the cylinder is indicated directly on the diagram, ranging from the pressure at release to the lowest back pressure, and this may be otherwise represented as follows: let the line, A B, be the centre line of the engine, and the circle, A B, the path of the crank. This circle may be adopted for

an ideal atmospheric line, upon which the exhaust pressure that exists throughout one revolution may be represented. To select No. 15 diagram from the *Great Britain*, for illustration, divide A B, (fig. 2,) into 24 parts, as inches of stroke, and draw ordinates to meet the circumference. Assuming the crank pin to move in the direction of the arrow; then, as the exhaust opens at the 20th inch of the stroke, the point *a*, where the 20th ordinate meets the circle, is the position of the crank pin at the time of release of the back stroke; and *b*, diametrically opposite, is the position for the front stroke. From these points draw radial lines to *c* and *d*, representing the release pressure, 42 lbs., on the diagram. Similarly, from the ends of the other ordinates for each successive inch of stroke, occurring within the semicircle, *a* A *b*, draw radii equal to the successive exhaust pressures set forth on the diagram, terminating with *b e*, the back pressure of 11 lbs., at the point of compression. The curve traced through the extremities of these radii will represent the exhaust pressure for half a revolution due to the back end of the cylinder. The termination of this curve at *e*, coincides with the commencement of the duplicate curve of exhaust pressure, *d f*, for the front stroke; and it is clear that the pressure of exhaust, though perpetual, is abrupt and variable.

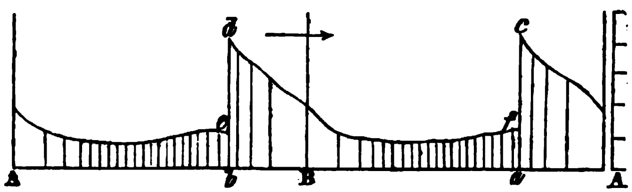
Fig. 2.



Great Britain.—3d Notch.—Variation of exhaust pressure in one cylinder during one revolution.

To represent this pressure on a straight atmospheric line, we may conceive the circular line, A B, to be unrolled flat with its ordinates attached. The diagram then assumes the appearance of fig. 3, in which the base line, A B A′, is equal to the circumference of the circle, A B, in the previous figure, and represents the path of the crank pin through one revolution. The ordinates being drawn from the points already found for them and connected by a curve, the curve so enclosed shows the exhaust pressure on a straight base line, for one cylinder, as before. The curve of exhaust pressure for the neighboring cylinder is of course precisely of the same form; and the two may be shown conjointly on opposite sides of the base. As the cranks are set at right angles on the axle, the re-

Fig. 3.

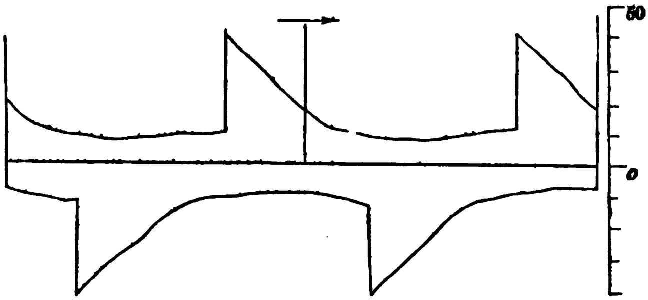


Variation of Exhaust Pressure, for one Cylinder.

lease points, represented at *d* and *c*, from one cylinder must occur at equal intervals between those from the other; and therefore the four explosions that occur during one revolution should be placed at equal intervals on the base line, as in fig. 4. To simplify the diagram, the whole area of pressure may be thrown to one side of the base line (as in fig. 5.), in which the ordinates from the second cylinder are superposed on the first series, and a

Fig. 4.

First Cylinder.

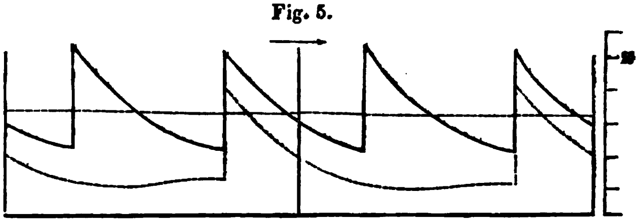


Second Cylinder.

Variation of total Exhaust Pressure.—Compound Diagram for one revolution.

heavy-lined curve is traced over all, to show the lump pressure of the exhaust steam from the two cylinders during one revolution,—deduced

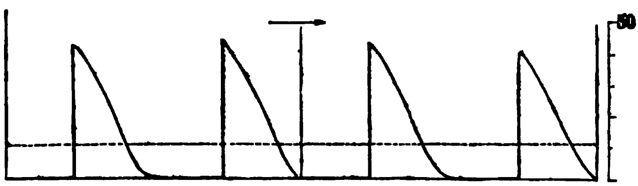
Fig. 5.



Great Britain, 3d notch, 46 m. p. h.—Previous Diagram simplified.

from the diagram No. 15 from the *Great Britain*. This figure clearly shows how far the joint pressure of exhaust may be reduced to a uniform force at high speeds, approximating the action of the blast to that of a steady jet of steam. The joint pressure, in this case, never falls below

Fig. 6.

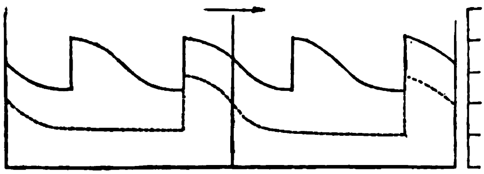


Great Britain, 3d notch, 11 m. p. h.—Variation of Exhaust Pressure for 2 cyls. 11 m. p. h.

21 lbs. in the cylinder; whereas, in fig. 6, showing the joint exhaust

pressure, in the same cylinders, at 11 miles per hour, drawn from No. 10 diagram, and projected in dot lining on fig. 2, we find the pressure developed in four distinct jets, each of which is isolated from its neighbors, and is thoroughly exhausted before the succeeding release takes place. The following figure, 7, showing in the same way the ordinary

Fig. 7.



C. R., No. 73, 30 m. p. h.—Variation of total Exhaust Pressure.

blast No. 73, C. R., at 30 miles per hour, still more obviously declares the approximation of the joint exhaust to a uniform pressure at high speeds. These illustrations explain, on the one hand, the clear "spit" of a well made engine with large ports and an easy orifice, proclaiming a rapid and efficient exhaust; and, on the other hand, the throttled shouts of overloaded steam ways, distressed by deficient dimensions.

The dot lines drawn in figs. 5 and 6, parallel to the base lines, indicate the mean exhaust pressures in the two cases, and measure respectively 33 lbs. and 11 lbs. Thus we perceive, in the latter case, a strong power of exhaust, capable of creating a blast without back pressure. A few examples of the proportional values of exhaust and blast pressures are contained in the following table:

TABLE No. XLIII.—*Comparison of Blast Pressure and the whole Pressure of Exhaust in the Cylinders.*

No. of Diagram.	Speed of engine.	Release pressure.	Mean total exhaust pressure for one cylinder.	Mean back pressure of exhaust for one cylinder.	Mean blast pressure for two cylinders.	
	m. p. h.	lbs.	lbs.	lbs.	inches of mercury.	lbs.
			C. R., No. 73.—2d day.			
1	25	41	16	10	4¾	2·4
2	32	29	11	6	4¾	2·4
3	32	35	16·5	13	5¼	2·6
			Do. 3d day.			
1	24	38	20	12	2½	1·25
2	30	30	15	12	1¾	1·4
3	34	21	9	7	1¼	0·6
4	39	28	12	10	2¾	1·4
			C. R., No. 124.—1st Notch.			
1	6	23	3	2	¾	0·4
2	12	38	7·5	5	7½	3·75
3	16	34	9	7	11½	5·75
4	18	30	12	10	9	4·5
5	22	34	12	10	18	9
6	24	28	12	10	12½	6·25
7	27	12	8	7·5	6½	3·25
8	28	20	11	10	13	6·5

In the case of No. 73, the insignificance of the blast pressure, in respect

of the mean exhaust, is striking. For example, on the second day, a mean exhaust pressure of 16 lbs. for one cylinder, does not raise above $2\frac{1}{2}$ lbs. of blast pressure for two; on the third day, still less. No. 124 yields higher values, as, with 12 lbs. mean pressure in each cylinder, it yields for the same speed of piston from $4\frac{1}{2}$ to 9 lbs. of joint blast pressure.

Again, a comparison of the blast pressure with the simple back pressure of exhaust, will abundantly prove how unlike the "resistance of the blast pipe" may be to the back pressure of the diagram. While No. 73 shows back pressures of 12 and 13 lbs., the blast does not in any case rise above 2·6 lbs., and is commonly but $\frac{1}{7}$th to $\frac{1}{12}$th of the other, reckoning even for one cylinder only. On the other hand, the blast of No. 124 is much more formidable, in some cases, as in No. 5 diagram, being nearly equal to the back pressure for one cylinder, and in general fully one-half.

It was observed also, that during the experiments with the *Orion*, E. and G. R., the blast pressure remained almost unaltered at about $\frac{3}{4}$ lb., while the back pressure ranged from about 8 lbs. with foul water, to nothing with clean water, in the boiler. These remarks are sufficient to show that the resistance at the blast orifice constitutes but a part, and in many cases a very small part, of the total back pressure on the piston. For this conclusion, now verified by actual experiment, we should be quite prepared by the investigations on back exhaust pressure in the fifth chapter, where the influence of various circumstances was set forth. It was there inferred that the influence of the blast area on back pressure is sensibly nothing when it exceeds the area of steam way, and only operates when it is smaller than any other part of the exhausting passage. This conclusion also is verified by the blast gauge; for we shall find that it is generally in the cases of the smallest orifice in proportion to the steam port, that the importance of blast pressure is greatest. Thus, in the following table, containing the mean results of above a hundred observations, it appears that in the *Hebe* and No. 124, in which the blast orifice is decidedly smaller than the steam port, the total blast pressure is about one-half of the back pressure in each cylinder; whereas, in the *Orion* and No. 73, with wider orifices, the proportion of blast is sensibly small.

TABLE No. XLIV.—*Mean Ratios of Blast to Back Exhaust Pressure.*

Name of Engine.	Ratios, that of piston being 1.		Mean observed pressures.		Ratio of blast to back pressure in one cylinder.
	Steam port.	Blast orifice.	Back pressure for one cylinder.	Blast for two cylinders.	
			lbs.	lbs.	
E. & G. R. Hebe, 4th Notch, . .	1-13·6	1-1·5	2	$\frac{3}{4}$	$\frac{3}{8}$
E. & G. R. Orion, 5th Notch, foul water,	1-14·7	1-12·2	8	$\frac{3}{4}$	1-11
Do. do. do. clean water,	1-14·7	1-12·2	0	$\frac{3}{4}$	—
C. R., No. 73, foul water, . . .	1-14·95	1-12·1	10	$2\frac{1}{2}$	$\frac{1}{4}$
Do. clean water, . .	1-14·95	1-12·1	10	$1\frac{1}{8}$	1-9
C. R., No. 124, 1st Notch, . .	1-15·1	1-22·7	8	5	$\frac{5}{8}$

It is unnecessary to pursue this comparison further. We are only con-

cerned in showing by direct experiment the fallacy of charging blast pipe resistance, without limitation, with all the back pressure that occurs in the cylinder.

Recapitulation.—1. The pressure of the blast, gauged at the orifice, is developed in pulsations, due to the alternate discharges of steam from the cylinder; sharp and isolated at the slower speeds, and sensibly uniform at the higher.

2. Blast pressure varies directly as the exhaust pressure in the cylinder at the point of release.

3. Blast pressure varies, generally, directly as the square of the speed.

4. Blast pressure, gauged for two cylinders, is in all cases much smaller than the mean exhaust pressure, even for one cylinder. Also, it is in all cases smaller than even the back pressure of exhaust alone; and in many cases it forms but an insignificant fraction of the back pressure. It has been observed to vary from $\frac{1}{11}$th to $\frac{5}{8}$ths of the back pressure in each cylinder. Blast pipe resistance, therefore, constitutes but a part, and commonly but a very small part, of the observed back pressure in the cylinder.

5. The observation of blast pressure shows that the influence of the area of blast orifice on back pressure is sensibly nothing when it exceeds the area of the steam port, and only operates as a cause of back pressure when it is less than any other part of the exhausting passage.—*Clark's Railway Machinery.*

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*The Submarine Telegraph between England and Belgium.**

On the 6th instant, a cable of seventy miles, in one entire length, was laid down between England and Belgium with complete success, and communications were instantly transmitted over 500 miles of submarine and subterranean line, with two of 24-plates battery only. The Mediterranean Electric Telegraph Company, propose to unite Europe with Africa by continuing the electric wires, which now run without interruption between London and Genoa, to Spezzia. From the latter port they will cross the Mediterranean to Africa, passing by the islands of Corsica and Sardinia. It is further proposed to construct a subterranean line from Algeria, along the coast of Africa to Alexandria: and, with the support of the British Government and the East India Company, it will be easy to prolong the wires to Bombay, where they will meet the great line of 3000 miles now in course of construction by the East India Company. The further end of this chain may ultimately be carried to Australia.

The Submarine Telegraph between Great Britain and Ireland.†

This important line of communication has at length been successfully effected by a submarine cable, manufactured by Messrs. Newall & Co., of Gateshead, and laid down by that firm on Monday between Donaghadee and Portpatrick. The cable consists of six communicating wires, insulated

* From the Journal of the Society of Arts, London, No. 27. † Ibid.

in gutta percha, and protected in the usual manner by an outer covering of iron wire. It could not be laid, as was intended, during the previous week, owing to the gales from the east preventing the opening of the dock gates at Sunderland to let the vessel containing it pass out. As several previous attempts to lay a submarine telegraph across the Irish Channel had failed, every care was taken to ensure the successful termination of the present attempt; and the expedition, consisting of the screw steamer *William Hutt* (with the cable and apparatus on board), the *Conqueror*, and the *Wizard*, left the Irish coast, having landed the end of the cable at a point about two miles to the south of Donaghadee harbor, and commenced the submersion of the cable, under the guidance of Captain Hawes, R. N., specially appointed by the Admiralty, who rendered great assistance in determining and directing the exact course to be pursued. The cable was landed on Wednesday morning, in a sandy bay (called Mora bay), a little to the north of Portpatrick.

A Description of the Newark Dyke Bridge, on the Great Northern Railway. By Mr. J. Cubitt, M. Inst. C. E.*

The structure consisted of two separate platforms, one for each line of rails, carried upon two pairs of Warren's trussed girders, each composed of a top-tubed strut, of cast iron, opposing horizontal resistance to compression, and a bottom tie, of wrought iron links, exerting tensile force; these were connected vertically, by alternate diagonal struts and ties, of cast and wrought iron respectively, dividing the length into a series of fourteen equilateral triangles, whose sides were 18 feet 6 inches long; the actual span of the girders being 240 feet 6 inches. Each tube was composed of twenty-nine cast iron pipes, of $1\frac{1}{2}$ inch metal and $13\frac{1}{2}$ inches diameter at the abutment ends, increasing to 18 inches diameter with $2\frac{5}{8}$ inches metal at the centre of the span. The lower tie consisted of wrought iron links 8 feet 6 inches long, of the uniform width of 9 inches, but varying in number and thickness, according to the tensile strain to which each portion was subjected. The diagonal tie links varied from 9 inches by $\frac{15}{16}$ inch to 9 inches by $\frac{3}{4}$ inch. The cast iron diagonal struts had a section resembling a Maltese cross, the area being in proportion to the compressive force to which they were subject. The total weight of metal in each pair of girders, composing the bridge, was 244 tons 10 cwt., of which 138 tons 5 cwt. were cast iron, and 106 tons 5 cwt. wrought iron, which with 50 tons for the platform, &c., made the total weight of each bridge 294 tons 10 cwt., or 589 tons for the whole structure; and the cost, exclusive of the masonry of the abutments, and of the permanent rails, but including the staging for fixing and putting together and the expense of testing, was 11,003*l.* In a series of experiments to test the stability of a pair of the trussed girders, at the works of Messrs. Fox, Henderson, and Co., where they were constructed, the following results were obtained. With a weight of 446 tons regularly distributed, which was equal to $1\frac{1}{2}$ ton per foot run, plus the weight of the platform, rails, &c., lowered seriatim on the thirteen compartments, the ultimate

* From the Journal of the Society of Arts, London, No. 27.

deflection in the centre was nearly 6⅞ inches. With a weight of 316 tons equal to 1 ton per foot run, plus the weight of the platform, &c., as before, the ultimate deflection at the centre was 4½ inches. When the bridge was fixed in its place, a train of wagons, loaded up to 1 ton per foot run extending the whole length of the platform, caused a centre deflection of 2¾ inches. The deflection caused by two heavy goods engines, traveling fast, and slowly, was 2⅛ inches; and that produced by a train of five of the heaviest locomotive engines, used on the Great Northern Railway, was 2½ inches in the centre.—*Proc. Inst. Civ. Eng., May* 24, 1853.

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*Iron Roofs of Large Span.**

(From a paper by Mr. Robert H. Bow, C. E., of Edinburgh, read at the Royal Scottish Society of Arts.)

After some introductory remarks, and insisting upon the propriety of employing roofs of great clear span for principal railway stations, the author institutes a comparison between the different classes of structures employed for the principals of roofs; and deduces that the *triangular frame* (in which the rafters constitute the main compressed member of the fabric) deserves to be preferred before all arched, compound, or other forms, when an inclined surface is demanded by the covering, of the character required for slating. And he further shows, that where uniting or abutting principals can be used, rafters, when made straight and treated as bridges, form principals of a very economical character; but that, for such a situation, rigid arched structures are quite inadmissible.

He arranges those straight-raftered principals in which the rafters are the main compressed members, into two classes; the first class embracing those which are tied, or exert only vertical pressures on the supports; and the second, those which are untied or of the abutting character. The principals of the tied class are of two kinds; in the principals of the first variety each rafter acts as a bridge; but the principals of the second partake of the nature of a framed girder. The designs proposed by Mr. Bow, are of the former variety—that is, each rafter is treated as a bridge, and they may therefore be employed either in the tied or in the untied state. In order to test their merits as suitable forms for long spans, they are compared with the best form at present in use for long spans, and which is of the latter or girder character.

In the calculations undertaken in order to make the comparisons, the weight of each part is represented by the product of the successive multiplication of its length by its strain, and the allowance of metal per ton of strain. For *ties*, the sectional area of metal is estimated at one-eighth of a square inch; for *rafters* at a quarter of a square inch; and for the *struts* of the bracing at half a square inch for each ton of strain.

The accompanying tables give the results of his calculations. In these, however, the effect of that source of economy of material which arises from the peculiar fitness of the proposed forms for cases requiring many supported points, is alone made evident. But if the strains in the struts of the several forms be compared, it will be found that the strains

* From the London Mechanic's Magazine, June, 1853.

in the best form now in use are relatively less than as the squares of the lengths; and, consequently, the allowance of metal per unit of strain should be greater for the struts of that form than would be necessary for the struts of those proposed by Mr. Bow. And therefore were that fact taken into account in the comparison, results would be arrived at still more favorable to the new forms than those displayed in the tables.

Comparative Weights of the Principals Nos. 1, 2, and 3.

First Case.—When the sections of the Rafters are proportioned to the Strains.

No. 1 refers to the best form now in use, and Nos. 2 and 3 to two forms proposed by Mr Bow.

No.	$N=16$	$N=20$	$N=24$
1 . .	100·000	100·000	100·000
2 . .	97·325	94·760	91·117
3 . .	99.674	——	92·129

Second Case.—When the Section of the Rafter is uniform.

No.	$N=16$	$N=20$	$N=24$
1 . .	100·000	100·000	100·000
2 . .	89·882	88·367	85·796
3 . .	89·353	——	83·898

N=number of Bays in the Span.

Comparative Weights of the Principals, Nos. 1, 2, and 3, when Nos. 2 and 3 are not tied.

No.	First Case.	Second Case.
1	100·000	100·000
2	75·690	71·176
3	78·046	70·653

Number of Bays in Span=16.

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*On the Evaporation of Water in Steam Boilers.—From Clark's Work on Railway Machinery.**

We take from a review of a work on Railway Machinery by D. K. Clark, contained in the January number of the *Artizan*, the following recapitulation of the results at which he has arrived, with the hope that our engineers and manufacturers who are practically familiar with these things, will let us know how far their experience agrees with that of the author.

Ed. Journ. F. I.

Recapitulation.—The quantity or weight of water evaporable per hour, at a given rate of combustion, increases with the temperature at which the water is pumped into the boiler.

2. Consequently, the equivalent *weight* of water evaporable from the standard temperature, 62°, decreases as the initial temperature of the water actually evaporated rises, at such a rate, that the equivalent weights fall 1 per cent. for every 10° rise of initial temperature. At this rate only 85 per cent. of water evaporated from 212° would be evaporable from 62°.

3. The equivalent *volumes* of water evaporable from 62° also decrease as the inital temperature rises; but rather more slowly than the equivalent weights, inasmuch as water expands by heat; 88 per cent. of water evaporated at 212° would be evaporable at 62°.

* From the London Artizan, January 1, 1853.

4. The evaporative efficiency of locomotives depends very much on the management of the fire. Low fires, in general, evaporate more water than deep fires, as there is less coke exposed to waste; the proper use of the ash pan damper also promotes the economy of combustion, by regulating the draft to the requirements of the time.

5. A poundage of water, equal to 9 lbs. per pound of coke, is adopted as the standard of economical consumption, in practice.

6. The rate of evaporation per pound of fuel, or the *poundage* of water, is regulated by the area of the fire grate, the extent of heating surface, and the rate of consumption per hour. In general, the smaller the fire grate, the greater the heating surface; and the less the consumption per hour, within certain limits, the greater is the poundage of water.

Conversely, the poundage of water falls nearly as the rate of evaporation is increased above the economic limit, involving a reduced efficiency, and a heavy sacrifice of fuel.

7. The maximum economical hourly consumption increases directly as the grate area is reduced, even with the same heating surface; showing that the economic value of heating surface is increased by reducing the grate, and that by this simple expedient the same heating surface can economically evaporate larger quantities of water per hour.

8. The economical hourly consumption increases directly as the square of the heating surface, with the same grate; so that twice the surface would yield four times the consumption; showing that the economic value of each foot of surface is increased *by merely increasing the surface.*

9. The necessary heating surface increases only as the square foot of the consumption, the grate being the same.

10. The necessary heating surface increases as the square foot of the grate, the consumption being the same.

11. As the economic value of heating surface depends so much on the grate area being less as the area is greater, the grate should be kept as small as is consistent with the demands for steam, and the practicable rate of combustion. On the other hand, there can be no economical objection to any amount of heating surface which can be got into a boiler, even though greater than the economic limits. Thus there are two ways of meeting defective proportions—by increasing the heating surface, or by reducing the grate, either of which increases the economic value of the heating surface,—in other words, the economic evaporative power of the boiler.

12. The relations of grate area, heating surface, and economical consumption are such that

with heating surfaces,	30,	60,	90,	100	times the grate,
the maximum economical consumptions are	2,	8,	18,	22	cubic feet of water per hour per foot of grate,
and	14,	55·6,	125,	153	pounds of coke.

13. The amount of clearance between the tubes affects the evaporative efficiency of the tube surface; and it ought to be greater, the greater the number of tubes. For ordinary good practice, on which the foregoing conclusions are founded, clearance at the rate of ⅛ inch for every 30 tubes is sufficient; for example, ½ inch for 120 tubes, ⅝ inch for 150 tubes, and ¾ inch for 180 tubes.

14. The maximum rate of efficient combustion of good coke in the firebox has been found in practice to be about 150 lbs. per hour per foot of grate; and of evaporation, about 22 cubic feet of water per hour per foot.

15. The minimum weight of combustion worth anything for evaporation is probably about 14 lbs. per hour per foot of grate.

16. The maximum rate of combustion recommended for locomotive boilers is 112 lbs., or 1 cwt. of coke per hour per foot of grate, when the grate has at least 8 feet of surface; and of evaporation, 16 cubic feet of water per hour per foot.

17. These rates of consumption require a heating surface of 85 feet per foot of grate; and this is the lowest proportion that should be adopted for locomotive boilers.

18. A grate area of 4 feet is probably the smallest that should be adopted for railway purposes; and as the smallest grates require the greatest attention in firing, a consumption of about 76 lbs. of coke, and 11 feet of water, per hour per foot of grate, is the highest duty for which 4 feet grates should be designed; for large grates the duty may be increased up to the standard for 8 feet grates.

19. The evaporative capacity of locomotive boilers appears, so far as experience goes, to be the same at all speeds.*

20. The economic evaporative value of coal is, according to ordinary practice, about two-thirds of that of coke. But as coal is not likely to come into more general use as fuel, and will continue to be used only as an auxiliary with coke, it is not necessary to reconsider the proportions of the locomotive boiler with any view to the increased employment of that fuel.†

For the Journal of the Franklin Institute.

Remarks on the Formation of Bars at the Mouth of the Mississippi River. By A. C. Jones, Esq.

To the Committee on Publications.

New Orleans, August 8th, 1853.

Gentlemen:—On May 4th, a well condensed synopsis of Mr. Ellet's report on the bars of the Mississippi river, appeared in the *Commercial Bulletin*, of this city, and on the 6th my remarks, (marked 1,) were pub-

* Assuming the efficiency of combustion to be the same, it might be deduced from previous discussions of the relations of evaporative power, blast pressure, vacuum in the smoke box, and speed, that the maximum rate of evaporation should be the same for all speeds. This question will be duly considered when we have to construct a general theory of the locomotive from the materials supplied by experiment.

† The author is gratified to find, from the later writings of Mr. Fairbairn, of Manchester, and Mr. Buchanan, of Glasgow, that his views of the economy of combustion and evaporation harmonize with those of these authorities. Mr. Fairbairn has, in his paper "On the Consumption of Fuel and the Prevention of Smoke" (1851), repeatedly recognised and set forth the value of a "*large heating surface as opposed to a small grate*," and the author is not sure but his formulas for economic proportions might apply to ordinary land or marine boilers. He feels certain that at least the principles on which the formulas are based will be found to apply to other classes of boilers.

lished in that journal; as only a part of the other communication is relevant to Mr. Ellet's theory, the rest may be omitted. Having just seen the book has induced me to send these on for republication.

Mr. E. gives, also, in support of the refluent current, the opinion of the pilots, which is, that this counter-current is the cause of vessels steering badly. Now, it is well known that most vessels answering the helm quickly in deep water steer wildly in shoal; hence this is no proof of this refluent current.

My opinion, published in 1841, and many times since, of the utter futility of attempting to improve the Passes of the Mississippi river, by any other mode than dredging a channel, and then keeping it open, is partly confirmed since. In 1843, the lateral outlet above the Passes, called the "Jump," was primarily caused by the shoaling of the Passes, and thereby not discharging the water fast enough during a rise, and the oyster canal* being the weakest point, the surplus was discharged through it; similar breaks will occur when the attempt is made to confine the discharge to one or two outlets.

The "scraping and stirring up plan" has been in operation several months by the tow boat company, to produce a depth of eighteen feet water on the bar, and so far their operations have done no good, as the water is now shoaler than when they began.

Respectfully, yours,

A. C. Jones.

*Note.—This canal was partly natural, and was only of sufficient dimensions to pass batteaux through it; the breech now is several hundred feet wide. For many miles (during high water,) the river is prevented flowing over the narrow strip of marshy ground on each side, by the trash collecting and forming a kind of levee.

Mr. Editor:—Permit me, through your columns, to make a few remarks in relation to a part of Mr. Ellet's theory of the formation of the bars at the mouth of the Mississippi River. *Under my present circumstances*, (a few days before, I was burned out,) I can spare little time to such matters, and therefore will be as brief as possible.

Having had ample facilities to watch, daily, the formation and peculiarities of the bars, for nearly fifteen continuous months, I can speak advisedly on the subject, and am satisfied that if Mr. Ellet could have had the same opportunities to study their character, he never would have advanced his present theory.

It is well said that the Mississippi is *sui generis*, and yet gentlemen pass a few days about the bars, try a few isolated experiments, and found their theories thereon, which are given to the world with the weight of their professional reputations to back them; thus many conflicting theories about the bars are promulgated, and are ingeniously supported by their authors.

In 1838–9 the Northeast Pass was considered the best channel, and as it has gradually shoaled its water, it may be taken as a fair specimen of the influence now at work in shoaling the Southwest Pass.

Mr. Ellet states that the downward current, some miles above the bars, was of the same velocity as the water passing immediately over the bars. Knowing Mr. Ellet, I have not the slightest doubt that such was the case *at the time he observed it*. Now, I, and many others, have seen *no current on the bar when there was a current above the Passes*, and have many times witnessed an upward current on the north-east bar—twice, the *ascending current being within a fraction of three miles per hour*, and the water all salt at that. In fact, the current is retarded in one Pass and accelerated in others, simply by the influence of the wind blowing in the mouth of one, and backing up the water, which finds an outlet through the other Passes.

I suspect that Mr. E.'s experiments, in which he draws the conclusion that there is a

stratum of salt water passing upward to a certain point on the bar, must have been made after a change in the direction of the surface current, as the slow top current of the two miles seems to support, (I have seen a current which a well manned whale boat could scarcely stem,) or else it was made at a place where the influence of some inequality of the bottom caused an eddy. I tried hundreds of similar experiments, and never succeeded in discovering a refluent current. When the surface current was not affected by foreign influence, at times there was salt water on the bottom, and this from its greater specific gravity remained until the surface current had regained a sufficient velocity to communicate motion to the bottom portion, and then the lower stratum would become fresh; sometimes there would be some saltish water, but this had been forced in some of the other outlets, and passed this way back to the Gulf.

If Mr. Ellet had seen the Gulf perfectly calm, he would have noticed that there was a lateral current for some distance on both sides, which kept up the supply of that portion of salt water which received its motion from the column of fresh passing through it.

I cannot reconcile his theory of the lower stratum of salt water having a daily duty to perform, of bringing in a portion of the material the river formerly held in suspension, depositing it on one point of the bar, then rising, and passing back to the Gulf, to return with another load; if this was the case, it would take but a short time to stop up the outlets. Again, it would make a narrow bar, running across the channel. It has been proved by accurate soundings, taken by the survey in 1838, that the channel on the bars was nearly uniform in depth, and that it was up and down stream, then nearly five-eighths of a mile, and it has also been well attested, that the bars *do make both up and down*. As I am not making out a theory, what I state are facts, which passed under my own notice. During a sluggish current, the river water *does deposit* a portion of the material held in suspension, as was proved by experiment. I found this pulpy mass, so deposited, at times to measure in depth eighteen inches, and in some instances, within a day, it would be reduced to two or three inches; again, it would scarcely be perceptible on the crust of the bar. After easterly gales, the surface of the bar would be covered over with a clean sea sand; I at one time found it to be nearly one inch thick. Now, with an instrument I was enabled to test the bottom, and found that it consisted, below this upper covering (whether of sand or mud), of thin layers of sand and river deposits, forming a hard and compact stratified mass. As these stratas were well defined, from what I have stated, most persons would arrive at the conclusion that by the change of current and material, these stratas are formed, and thus shoals the whole surface of the bar. This will also account how the bar makes up stream, and also to the Gulf; and as the "mud lumps" assist, in the extension seaward, I will say a word about them. "Mud lumps," as they are miscalled, consist of pure clay,* (entirely different from the matter held in suspension by the water, which is more of the nature of loam;) it is proved to be composed of an impalpable material; in its natural state it is compact and tough, not easily washed or abraded by the action of the waves on it; when dried, it admits of a fine polish, which it retains for years.

These islands are forced up by subterranean agency sometimes twelve or fourteen feet above the surface of the water, with nearly perpendicular sides, and have always one or more salt springs discharging from their tops, a *much salter water* than that of the Gulf; along with this water comes bubbles of an impure hydrogen gas. Of course, where these islands are formed the current is retarded and the channel changed.

To obtain information of these "lumps," I had placed a skiff across the crater of a small one forming near the light-house, and let myself down through the pulpy mass to my armpits, when I found the bottom comparatively solid. I did not remain quite a minute, and yet the cold was so intense that, although I was in robust health, and the thermometer stood above 90°, it was nearly two hours before it seemed that I had a natural circulation at the extremities.

Respectfully, A. C. Jones.

* Imbedded in one of the mud lumps, or islands, there was a column (slightly inclined) of pure sand, which, by probing with a pointed iron rod, was at first mistaken for the trunk of a tree. All the rest of the island was pure alumine.

AMERICAN PATENTS.

List of American Patents which issued from July 19th, to August 9th, 1853, (inclusive,) with Exemplifications by Charles M. Keller, *late Chief Examiner of Patents in the U. S. Patent Office.*

JULY 19.

27. For an *Improvement in Press Mould Candles;* Samuel T. Barnes, Columbus, Ohio.

Claim.—"What I claim is, the wick tube to guide and retain the wick in the centre of the candle, in combination with the wick, so arranged on a spool as to supply a continuous wick, as the tallow is forced out to form the candle, substantially in the manner described."

28. For an *Improvement in Processes for obtaining Chromates;* James C. Booth, Philadelphia, Pennsylvania; patented in England, November 9th, 1852.

Claim.—"I do not desire to claim separately as my invention such portion of the process herein before described as I have stated to be similar to that now in use for manufacturing chromate and bichromate of potash." "But what I do desire to claim is, 1st, The reduction of chrome ore by the carbonaceous materials, as herein described, as a stage in the manufacture of chromate of potash. 2d, The art or process of manufacturing chromate and bichromate of potash from chromic iron ore, by means of the reduction of the oxide of iron and the removal of the reduced iron by the several substances and modes, substantially as are herein enumerated and set forth. 3d, The process of reduction and removal herein described, in connexion with the old process of reduction herein described, or in combination with any equivalent therefor."

29. For an *Improvement in Feathering Paddle Wheels for Steamers;* Alexander H. Brown, Washington City, D. C.; patented in England, March 5th, 1853.

"The advantages possessed by my paddle wheel, in addition to those possessed by other adjustable wheels, are, 1st, the paddles having the curved form have a much greater propelling power than an ordinary flat paddle, as the paddle acts upon the water like the curved foot of the duck."

Claim.—"What I claim is, the combination of the pinion, back cam, and steering drum, with the eccentric, for the purpose of adjusting the paddles and converting them into a powerful steering apparatus." "I also claim the combination of the curved paddle with any apparatus for adjusting and feathering the same."

30. For an *Improvement in Mode of Driving Saws;* Issac Brown, Baltimore, Md.

Claim.—"What I claim is, the mode herein described of applying the power of the engine to the saw gate or frame, without being permanently connected therewith, so that the piston shall in a great measure be relieved from any lateral motion which the gate may have, which causes it to bind or cut in the cylinders, substantially as described."

31. For an *Improvement in Hanging Saws;* Nathan T. Coffin, Knightstown, Indiana.

Claim.—"What I claim is, the combination of the stirrup hung upon a knife edge, with the adjusting screws, for the purpose of regulating the rake of the saw in the manner described."

32. For an *Improvement in Lamps;* Charles J. Conway, City of New York.

"The objects of my invention are, first, to make the base of the lamp serve as a reservoir for the burning fluid; secondly, to establish such a communication betweeen the reservoir and the wick chamber, that the latter may be supplied from the former at any moment, by simply changing the position of the lamp; and, thirdly, to prevent any danger of explosion when the fluid used is of an explosive nature, by keeping it constantly confined within permanent and flame-tight limits."

Claim.—"I do not claim the peculiar property of small tubes, preventing the passage of flame; neither do I claim the making the base of the lamp serve as a reservoir for the fluid used; nor do I claim the construction by which no part is made movable, but the cap of the feeding tube." "But what I do claim is, that peculiar construction, by which two chambers or reservoirs are combined in the same lamp, one containing the wicks and

the fluid which saturates them, and the other forming the receptacle into which the fluid is poured, and the two chambers communicating by means of two pipes or tubes; the whole arranged and operating as described; by which means the wick chamber is filled, and may at any time be replenished from the larger reservoir by simply changing the position of the lamp from a vertical to a horizontal direction; and the larger reservoir may be suppled without bringing the can or fillers near the burners."

33. For an *Improvement in Spinning Jacks;* John Jackson, Lawrence, Massachusetts.

Claim.—"I do not claim stripping the bobbins preparatory to winding on; neither do I claim raising the "former," by a horizontal screw, giving motion to an inclined plane beneath it. But what I do claim is, the stop, in combination with the tappet on the gear, for the purpose of arresting the motion of the latter, at the instant the belt is shipped upon the pulley, that the gear may be left in the precise position necessary for the performance of another duty, the instant it is again set in motion, without being carried past this position by momentum and otherwise, when the brake is so arranged in connexion with the lever, or otherwise, that it shall be withdrawn by the mechanism which shifts the belt at the instant the gear is again set in motion; the operating the winding on mechanism, raising the stripping wire, and depressing the building wire, in the proper order, and then slipping the belt on the fast pulley at the close of these operations, by means of a single cogged gear, in combination with the tappet placed upon its side; the whole arranged and combined in the manner substantially as specified."

34. For an *Improvement in Eyes for Mill Stones;* Edmund Munson, Utica, New York.

"My invention consists in so constructing the eye of the stone, that the central cone supporting the runner shall be sustained by spiral wings extending from the cone to the inner surface of the eye; these wings so constructed as to prevent choking and clogging; and causing a current of air to pass into the eye and between the stones, thus facilitating the feeding of the grain and also supporting the stone."

Claim.—"I do not claim a conical form of a portion of the eye, nor do I claim a metallic eye, for they have been previously used and arranged in a variety of ways." "But what I claim is, the spiral wings, arranged in such manner as to perform the double office of feeding the grain and supporting the stone."

35. For an *Improvement in Machines for Ditching;* Ralph C. Pratt, Canandaigua, New York.

Claim.—"What I claim is, the ditching machine, consisting of a beam and casing, or their equivalents, in one or more parts, with a cutting and scraping point, hung on the shaft of a revolving wheel, with shovels attached to the outer circle of the wheel, which self act by turning the wheel and forming a bucket, in connexion with the casing, so as to carry up the earth to the inclined slides, the whole being operated and constructed substantially as herein described."

36. For an *Improvement in Lining for Fire Proof Safes;* John Farrel, Philadelphia, Pennsylvania.

"The nature of my invention consists in the introduction of flour, grain, or other vegetable substances into the space which in such safes is usually filled with non-conducting materials. I have found it useful to combine with them lime, cement, or other similar and well known materials, usually employed to give a set and hardened character."

Claim.—"What I claim is, the application and use of flour, grain, maize, starch, or other vegetable substance of a like nature, either alone or in combination with lime, cement, or similar substances, in the construction of fire proof chests or safes, substantially as described."

37. For an *Improvement in Gripes for Holding Leather;* Bradford Rowe, Albany, New York.

Claim.—"I claim the construction of a gripe composed of a key, turning within a socket or chamber, the key being a solid cylinder, with a portion of its surface cut away in two faces parallel with its axis, and at an angle with each other, one face being grooved lengthwise, and the chamber being a hollow cylinder, with a portion of its space filled up parallel with its axis, and having a longitudinal slit through it for nearly its whole length, corresponding with the cut away part of the key, so that when the key is in the chamber, a strap of leather or other material can pass through the chamber and under the key, as described."

38. For an *Improvement in Grain Winnowers;* George B. Salmon, Elmira, New York; ante-dated, July 6th, 1853.

"The nature of my invention consists in cleaning and separating grain by means of a blast spout screen and troughs, arranged in a manner which will be hereafter described, by which the grain is perfectly separated from the improper substances which are usually mixed with it previous to being separated, and the grain, as well as the different sorts of improper substances, conveyed to separate places, and kept distinct or separate from each other."

Claim.—"I do not claim the blast head, or the blast spout B, separately; neither do I claim the screen F, nor the trough and spouts MM, separately." "But what I do claim is, 1st, The expansion of the upper part of the blast spout B, into the circular irregular enlarged head, with an opening or mouth at the lower extremity, partly covered with the sieve E, for the purpose of allowing the force of the blast to be exhausted, the screenings immediately falling through the opening or mouth of the head while the blast and dust escape through the screen E, the blast being governed by a slide, substantially as fully set forth and described. 2d, I claim the arrangement and construction of the graduated sieve (*a b*,) of unequal fineness, the portion *a*, being protected from the action of the fan blast, so that the small substances, such as cockle, &c., passing through and falling on the bottom board of the sieve *a*, passes off at the trough and spouts MM; and when the grain arrives at the coarser part of the sieve *h*, it passes through and is acted upon by the fan blast, while larger substances than wheat pass over the end of the sieve *h*, and fall on the floor, substantially as set forth."

39. For an *Improvement in Ovens;* Ephraim Treadwell, City of New York.

Claim.—"What I claim is, the use of a perpetual oven, having side doors in it, for charging and discharging it, at intermediate points between the ends of the oven, in combination with the upper and lower independent heating flues and furnaces, for directing the entire heat from one set of furnaces through flues on the upper side of the article to be baked, and the entire heat from the other independent set of furnaces through flues on the under side of the article to be baked, substantially as set forth."

40. For an *Improvement in Compressers for Flyers;* William H. Thompson and Richard H. Plummer, Biddeford, Maine.

Claim.—"We claim the combination of the guard rib *e*, with the hole *a*, and the passage *b*, and the opening *d*, substantially in manner and for the purposes as specified."

41. For an *Improvement in Spike Machines;* Philip P. Trayser, Baltimore, Maryland.

Claim.—"What I claim is, the combination with the knife which severs the blank from the rod, of two stumps, either or both moving, whereby while one blank is being headed and pointed in the dies, the end of the rod for the next blank is cut off and bent preparatory to forming a head, substantially as described. I also claim the method of heating spikes by bending the end of the rod, preparatory to upsetting, before placing it in contact with the heading dies, instead of giving it the preparatory bending while in contact with the dies, and therefore heats them less, while at the same time it is not detained longer than usual out of the dies, so that by this method the dies are better protected from excessive heating, the rod from cooling, and the whole operation expedited and improved, substantially as set forth."

42. For an *Improvement in Mounting Spirit Levels;* Sylvester I. Sherman, City of New York.

Claim.—"What I claim is, the spring catch for holding the level in place upon the square or ruler, in combination with the bearers, the latter being so formed with respect to the level, that when they are placed upon a horizontal line, the bubble will be in the middle of the glass, and thus a horizontal or a vertical line may be ascertained from a ruler, or from a square, when said level is attached, substantially as set forth."

43. For an *Improvement in the Manufacture of Wigs;* Thomas C. Weildon, Hartford, Connecticut.

"The nature of my invention consists in the method of fastening and attaching the hair with a gluten to the frame work, body, or net work, of wigs, toupees, bands, braids, curls, &c., or any other kind of hair-work, now in use or that may be in use hereafter."

Claim.—"What I claim is, the method of fastening and attaching the hair to wigs,

toupees, or any other kind of hair work, by means of any kind of glutinous substance, substantially in the manner and for the purpose substantially as described."

44. For an *Improvement in the Preparation of Bristles for Brushes;* Charles Williams, Philadelphia, Pennsylvania.

"The nature of my invention consists in the mode of preparing the bristles by the application of heat (by steam or otherwise) to the roots of the bristles."

Claim.—"What I claim as new in the manufacture of that class of brushes known as "drove work," is preparing the bristles by application of heat to the roots, substantially in the manner and for the purpose which I have set forth."

45. For an *Improvement in Gutta Percha Stereotype Compositions;* Leonardo Westbrook, City of New York.

Claim.—"What I claim as my invention and improvement, on the patent of Josiah Warren, dated April 25th, 1846, is, 1st, The compound herein described of shellac, plumbago or graphite, asphaltum, and gutta percha, treated by sulphate of copper and water, in the manner described, as a substitute for type metal."

46. For an *Improvement in Air Engines;* Austin O. Willcox, Philadelphia, Penn.

Claim.—"Having thus fully described my improved caloric air engine, what I claim is, the interchanging circulators, situated within, and occupying one half of the capacity of each heat reversing vessel, and so arranged as to alternately transfer the air or other fluid to the heating and cooling divisions of said vessels; in the same movement to cause the air to pass through renovating plates, or their equivalent, whether placed within the circulators and transmitting the air, or placed without the circulators and the air forced through them, substantially as herein described. I also claim, placing an inwardly pressing packing, in the open end of each working cylinder, and in combination therewith, the construction of the working piston (being of the requisite length) of a little less diameter than the interior of the cylinders; whereby the friction surface is confined to the periphery of the piston, in order to sufficiently exclude its lubricating fluid from the contact of the hot air within the cylinders, substantially in the manner herein set forth." "I also claim the barrel and stationary hollow piston, with its supply tube, aperture, and valves, in combination with the working piston and its valves, for the purpose of supplying air or other fluid to the cylinders, when desired, substantially as herein described."

47. For an *Improvement in Paper Cutting Machines;* Frederick Hesse, Assignor to H. J. Oerter, Bethlehem, Pennsylvania.

"The nature of my invention consists in having an adjustable knife or cutter, placed within a sliding stock, and so arranged, that said knife or cutter may be regulated to cut the required depth, by merely turning the handles by which the sliding stock is moved upon the bed."

Claim.—"I do not claim a stock provided with a knife or cutter working on a bed piece, irrespective of the employment and arrangement of the rack bar and pinion, as that has been previously used." "But what I claim is, cutting paper, pasteboard, or other articles, by means of a knife or cutter, attached to a rack bar, which mashes into a pinion, said pinion being hung or attached to a spindle or shaft, to the ends of which the handles of the sliding stock are secured; the above parts being attached to the sliding stock, by which device the knife or cutter may be elevated or depressed, as desired by the operator, while working the sliding stock upon the bed piece, as set forth."

July 26.

48. For an *Improvement in Shower Bath Tables;* Cyrus C. Bisbee, Rochester, N. Y.

"My improvements consist in the construction and arrangement of a shower bath, in such a manner that, when not in actual use as a bath, it may be converted into a table, adapted to the common uses of such an article of furniture."

Claim.—"What I claim is, the combination of the upper and lower tray, substantially as herein described, so that they shall simultaneously recede from each other to elevate the water and set up the bath, and approach each other to pack away the bath and convert the apparatus into a table."

49. For an *Improvement in Rotary Steam Engines;* Richard C. Bristol, Chicago, Ill.

Claim.—"What I claim is, the combination and arrangement of the outward radiating pistons, or their equivalents, with the sliders, steam-ways or passages, and abutments, in

such manner that the sliders are free from lateral friction by pressure of the propelling medium in passing the abutments, and are worked outwards and kept up to their bearing by the pistons, substantially as specified, whereby promptness and certainty is insured in the outward action of the sliders, counteracting pressure to their inward radiation removed, and a tight but free action of the sliders through their entire travel produced, essentially as set forth."

50. For an *Improvement in Ploughs;* Wm. V. Burton, Orange, Ohio.

Claim.—"What I claim is, 1st, the manner of securing the points of the land side, land cutter, and counter side, by the lock couplings or joint, formed in the mortise by the curvature of the tenons, as herein set forth. 2d, The plough point, and a reversible land side piece, in the manner specified, whereby the land side piece and point are made reversible."

51. For an *Improvement in Mills for Grinding Apples and other Substances;* F. B. Hunt, Westfield, Indiana.

Claim.—"I do not claim the employment of the endless belts, irrespective of their arrangement, as they have been long used; neither do I claim the cutters nor cylinder press separately; but what I claim is, 1st, the employment or use of the endless belts, arranged as described, viz: the upper belt, having an adjustable roller, which, upon being elevated or depressed, causes the belts at the discharge ends to be brought nearer together, or separated further apart, thus allowing the belts to be adjusted, to feed or convey to the cutter all the different articles or substances which at present require each a separate and distinct machine. 2d, I claim, in combination with the two endless belts arranged as described, one or more cutters or cutting cylinders; said cylinders being placed loosely on their axes, and secured by set screws, as herein described, by which several forms of cutters may be used, according to the work required to be performed."

52. For an *Improvement in Processes for Making Glue;* David A. James, Cincinnati, Ohio.

Claim.—"1st, The method substantially as described, of preservation and conversion into glue, of the tanners' scraps, &c., by open piling successive layers of scrap, coated by cream of lime, (in place of the lime steeping heretofore resorted to,) followed by the application of sulphuric or other suitable acid, which, combining with the lime, prevents the deleterious action on the glue, and supersedes the necessity of the atmospheric exposure now resorted to. 2d, The combination with the said previous treatment, the process substantially as described, of making glue by means of the combination of direct and indirect steam, acting in concert, or separately, according to the stage of the process, and the relative heat and moisture required, avoiding on the one hand, the injurious scorching effects of the open furnace, and on the other hand, the serious inconvenience of undue dilution by the open steam jet."

53. For an *Improvement in Lamps;* Owen Redmond, Rochester, New York.

Claim.—"What I claim is, resting the oil fountain for lamps upon a spring or springs, so constructed as to retain the surface of the oil in the fountain constantly at a nearly uniform height; and this I claim, whether used with or without a float, as above described and set forth."

54. For an *Improvement in Seed Planters;* Milton Satterlie, Louisa, Illinois.

Claim.—"What I claim is, the arrangement of the drill and covering wheels, or their equivalents, on flexible axles, so that the said wheels, or their substitute, will rise and fall to accommodate themselves to undulating ground, whereby the grain in all the furrows is planted at an equal depth and equally covered, substantially as specified."

55. For an *Improvement in Railroad Car Seats;* Wm. M. Warren, Watertown, Conn.

"The nature of my invention consists in attaching the hinged back to the stationary back, in such a manner that the seat will be inclined as the hinged back is raised and brought to a horizontal position, when the hinged back is depressed and placed against the stationary back."

Claim.—"I do not claim a rotating seat, for they have been previously used; but what I claim is, attaching the hinged or adjustable back to the stationary back, by means of the hinges, *b b*, and having a jointed or hinged metal strip, *e*, secured to the adjustable back, and to the cross-piece; the hinge or joint, *d*, of the metal strip being above the line of the

hinges, *b b;* by which arrangement the seat is inclined, or brought to a horizontal position, as the adjustable back is raised or depressed, as shown and described."

56. For an *Improvement in Bran Dusters;* Ezra R. Benton, Cleveland, Ohio.

Claim.—"I am aware that in a bran duster, patented February 27th, 1849, a fan with oblique wings is employed at the top of the machine for producing a draft of air into the same, and a fan with wings parallel with the axis of the cylinder is employed at the bottom of the machine, for sweeping the bran from the bottom of the machine into a lateral opening in the side of the same; and therefore, I wish it to be understood that I do not claim the said arrangement and character of fans in a bran duster, as in my invention; but what I do claim is, the combination of the two inwardly acting drafts of air of different degrees of strength, produced by the oblique fans when their forces are proportioned in such a manner that the upper blast will feed the bran into the machine and drive the flour through the sieve, while the lower current only counteracts the downward pressure of the upper blast, so as to prevent any flour from falling to and being discharged with the bran at the aperture in the bottom of the duster, substantially as described."

57. For an *Improvement in Corn Planters;* Jacob H. Carothers, Davidsburgh, Penna.

Claim.—"What I claim is, the method of stopping the seeding apparatus by grappling the periphery of the driving wheel, in the manner herein described."

58. For *an Improvement in Bee Hives;* Sylvester Davis, Claremont, New Hampshire.

Claim.—"What I claim is, the manner of constructing the float, viz: of two parallel series of slightly separated thin slats, placed one directly over the other, and separated by two or three cross slats, and supported by similar cross slats beneath the whole, for the purpose of allowing the bees to feed without being liable to be mixed in the food beneath."

59. For an *Improvement in the Beaters of Smut Machines;* Ziba Durkee, Alden, N. Y.

Claim.—"I am aware that the concave in smut machines has been made of wire netting, but as this remains stationary, it does not become so much worn by use, nor does it perform so active a part in the beating and scouring of the grain as the revolving cylinder; this I do not claim; neither do I claim a revolving wire cloth cylinder; but what I do claim is, the covering of the revolving cylinder, wings, or beaters of smut machines with wire netting or cloth, for the purpose of providing an uneven but smooth beating or rubbing surface, and at the same time give great durability to the said parts, substantially as described."

60. For an *Improvement in Omnibus Lanterns;* F. O. Deschamps, Philadelphia, Pa.

Claim.—"What I claim is, constructing the case of the lamp in the manner substantially as described, viz: the lower part of the case being constructed of glass, and the upper part of metal, having a lens inserted in it, by which construction the lamp, when placed as herein shown, is made to illuminate the interior of the omnibus, or stage, and also to afford light on the top or roof of the omnibus or stage, to enable the driver to see distinctly what money or ticket he may receive, and to facilitate him in giving change."

61. For an *Improvement in Covering the Backs of Books;* John A. Elder, Westbrook, Maine.

Claim.—"What I claim is, 1st, hanging the frame carrying the pressure roller upon, and eccentrically to the centre of motion of the arms, so that the centre of motion of the frame can be raised at pleasure, in the manner and for the purposes described. 2d, The combination of the wedge and bars, when connected with the jaws of the clamps, as described, for the purpose of keeping the centre of the book, whatever its thickness, vertical with the bearings of the swinging frame, as described and set forth."

62. For an *Improvement in Dyeing Yarn Parti-Colored;* Daniel B. Hinman, Philadelphia, Pennsylvania.

Claim.—"What I claim is, the employment of series of separate and adjustable or changeable bars, one above the other, in an adjustable press, and pressing between their faces the parts of the yarn not intended to be dyed, while the liquor is in contact with and dyes the parts of the yarn between the sides of the bars, substantially as described."

63. For an *Improved Plotting Theodolite;* Levi Pitman, Tom's Brook, Virginia.

Claim.—"What I claim is, 1st, the adjusting index, or its equivalent, in combination with the graduated scale upon the traversing ruler, and the horizontal dial, substantially as described. I do not claim a rotating drafting board turning upon a fixed centre pin in

a protracting arch, with a traversing ruler working upon two graduated parallel guide strips, such as have been used heretofore; but what I do claim is, a dial, such as is herein described, fixed upon a staff or socket, in combination with the revolving frame, (turning under said dial on the socket,) and carrying the traversing ruler, and a suitable sight vane, constructed and operating as described."

64. For an *Improvement in Straining Saws by Compressed Air;* Jackson A. Rapp and Edward S. Wright, Buffalo, New York.

"The nature of our invention consists in the application of compressed air, so applied to piston heads working in cylinders at each end of the saw, and to which heads the saw is connected by its ends by rods, as that the tendency of the compressed air to push or pull apart the piston heads, shall be exerted to the straining of the saw, and thus keep it perfectly strained without the use of a gate or saw frame."

Claim.—"What we claim is, the application of compressed air to the straining cylinders of saws, when said cylinders are so connected with each other that the compressed air shall alternately pass from one cylinder to the other, during the reciprocating action of the saw, and combined with the air pump and pressure valve, for the purpose of regulating and maintaining the intensity of the steam on the saw, substantially in the manner described."

65. For an *Improvement in Dyeing Compounds;* Frederick G. Vettercke, City of New York.

Claim.—"What I claim is, the making of the kali compound, substantially as herein set forth, as a basis for a blue dye."

66. For an *Improvement in Preserving India Rubber in the Liquid State;* Henry Lee Norris, Assignor to Samuel T. Armstrong, City of New York; patented in England, February 24, 1853, and in France, March 13, 1853.

"The nature of my invention consists in treating the milk or juice drawn from the caoutchouc, or india rubber tree, so as to form a compound which remains liquid, and is prevented from fermentation, acidulation, coagulation, or becoming putrid, and which can therefore be transported to remote places without decomposition or deterioration; and also, in so treating this composition as to produce therefrom a new and useful article of manufacture."

Claim.—"What I claim is, the compound, consisting of the native juice of the caoutchouc, with aqua ammonia, or the equivalent thereof, substantially as herein set forth, when said ammonia, or its equivalent, is mixed with said juice of the caoutchouc in a liquid state, by means of which the juice above named is preserved for a great length of time, and can be manufactured at less expense than the india rubber of commerce, which is mixed with other foreign substances. And I also claim the solid elastic article when manufactured from the said composition of matter, as above described."

Re-issues for July, 1853.

1. For an *Improvement in the Process of Flouring;* David P. Bonnell, Tecumseh, Michigan; patented August 14, 1849; re-issued July 5, 1853.

Claim.—"What I claim is, the process of grinding the offal of grain immediately after it has passed from the bolts, contemporaneous with the first flouring, and by the continuous operation of machinery adapted to said process, substantially as set forth, for the purpose of increasing the quantity and improving the quality of the superfine, or other flour."

2. For an *Improvement in Composition for Stereotype Plates;* Leonardo Westbrook, City of New York, Assignee of Josiah Warren, Posey, Indiana; patented April 25, 1846; re-issued July 26, 1853.

Claim.—"What I claim is, 1st, The mixture (herein described) of shellac, tar, and sand, as a substitute for type metal. 2d, The use of shellac as a basis to form a substitute for type metal, when it be mixed with the substances I have mentioned, or with other substances of a similar nature. 3d, The use of clay mixed with sand in various proportions; also, with gum arabic, beeswax, stearine tallow and oil, as before described, for the purpose of engraving or forming matrices or moulds, in which to make casts for typographical purposes, of the material and in the manner substantially set forth. 4th, The use of clay as a basis from which to form matrices or moulds, as aforesaid, whether it be mixed with the materials I have mentioned, or whether other substances be used instead of them, but substantially of the same nature. 5th, I claim, in combination with the employment of plastic

material for stereotyping, the employment of the bearers, in the manner described, for the purpose of obtaining casts exactly level and of type height."

DESIGNS FOR JULY, 1853.

1. For a *Waffle Baker;* Nathaniel Waterman, Boston, Massachusetts, July 5.

Claim.—"I claim the design for the waffle plate, or mould, substantially as exhibited in the drawings."

2. For a *Cook Stove;* Samuel Pierce and James J. Dulley, Assignors to Johnson, Cox, & Fuller, Troy, New York, July 12.

Claim.—"We claim the ornamental design and configuration of cook stove plates, such as described and represented."

3. For a *Cooking Stove;* John Mason, Assignor to Hight Street Furnace Company, Providence, Rhode Island, July 19.

Claim.—"The new design, consisting of the flower work and ornamental figures composed of raised leaves and spear heads, described and represented, for the front, side, and back plates of a cooking stove."

4. For a *Cooking Stove;* Johnson, Cox & Fuller, Assignees of James J. Dulley, Troy, New York, July 19.

Claim.—"I claim the ornamental design and configuration of cook stove, such as described and represented."

5. For a *Sewing Bird;* Julius E. Merriman, Meriden, Connecticut, July 26.

Claim.—"I claim the design and configuration of the sewing bird at rest, as described and represented."

6. For a *Parlor Stove;* Elihu Smith, Albany, New York, July 26.

Claim.—"I claim the combination and arrangement of ornamental figures and forms represented."

7. For a *Stove;* Hosea H. Huntley, Assignor to Daniel F. Goodhue, Cincinnati, Ohio, July 26.

Claim.—"I claim the combination and arrangement of the ornamental forms and configurations represented, forming an ornamental design for a stove, as described."

8. For a *Cooking Stove;* Hosea H. Huntley, Assignor to Daniel F. Goodhue, Cincinnati, Ohio, July 26.

Claim.—"What I claim is, the combination and arrangement of the ornamental forms and configurations of a cooking stove, as described."

9. For a *Cooking Stove;* Thos. Barry, City of New York, Assignor to North, Chase & North, Philadelphia, Pennsylvania, July 26.

Claim.—"What I claim is, the design and configuration of the mouldings and ornamental work, as herein described."

10. For a *Cooking Range;* Reuben H. N. Bates, Providence, Rhode Island, Assignor to North, Chase & North, Philadelphia, Pennsylvania, July 26.

Claim.—"What I claim is, the design and configuration of the moulding and ornamental work, as herein described."

AUGUST 2.

1. For an *Improvement in Reed Musical Instruments;* James A. Bazin, Canton, Mass.

Claim.—"What I claim in the construction of organs, reed, and other similar instruments of music, is, 1st, Flatting the thirds, sixths, and sevenths of the scale, by means of the regulating cylinder, constructed as described, or by any other analogous contrivance, in the manner and for the purpose substantially as set forth. 2d, The valve constructed as described of the two parts *s* and *o*, with the springs *u* and *v*, or their equivalents, in combination with the perforated plate, for the purpose of sounding the note flat or sharp, as set forth. 3d, The combination and arrangement of the sliding bar, the buttons, the bent wires, by which means the key board may be locked and moved in either direction by one

hand, in the manner set forth. 4th, The use of two or more wind chests in the same instrument, for the purpose of providing a separate supply of air for the bass and treble notes, as herein set forth. 5th, The peculiar arrangement of the bellows and wind chests; the latter being placed below the former, and communicating with the reed box, by means of flexible passages passing up through the bellows, as described; which arrangement of parts enables me to make use of two wind chests, in the manner and for the purpose set forth. 6th, Hanging the pedal with a movable fulcrum, to prevent friction upon the foot, and to enable it to be operated with more ease and convenience, as set forth. 7th, The construction and arrangement of the air passages above and below the reed, as described, for the purpose of admitting the air, and permitting it to escape at the but end of the reed, as set forth. 8th, The presser bar, so constructed and arranged as to keep down the rear portion of all the valves, while their front portion is left free to be operated by their keys, thereby modifying the tone of all the notes of the instrument, as set forth."

2. For an *Improvement in Seed Planters;* George W. Brown, Tylerville, Illinois; antedated February 2, 1853.

Claim.—"What I claim is, 1st, The oscillating horizontal wheels, or distributors, in the bottom of the hoppers, having slots and holes of various sizes, in combination with the stationary caps and pins, for the discharge of different kinds and quantities of seeds, as set forth. 2d, The arrangement of the covering rollers, mounted as described, and performing the purpose of covering the seed, elevating the cutters in turning around, and also in adjusting them to different depths, as set forth."

3. For an *Improvement in Seed Planters;* Lebbeus Caswell, Harrison, Maine.

Claim.—"What I claim is, placing the axle of the gauge wheels on a fulcrum in an adjustable slide, as above described, so as to plant at any desired and at the same time a uniform depth, as above set forth."

4. For *Apparatus to Regulate the Supply of Water to Steam Boilers;* Samuel R. Clime, District of Spring Garden, Pennsylvania.

Claim.—"What I claim are, the water chambers, as described, and the contrivance and machinery by which their action is aided and facilitated.

5. For an *Improvement in Abdominal Supporters;* A. B. Conant, Geneva, Wisconsin.

Claim.—"What I claim is, constructing it with two encompassing springs, attached respectively at their centres to the front and hind pads, (the hind spring being slightly curved upwards in the middle, and the front spring correspondingly curved downward, and both springs straight on their flat sides, as described;) and uniting said springs at their adjacent ends with straps of adjustable lengths, whereby its pressure may be varied at pleasure, and the same supporter worn by persons of different sizes, substantially as set forth."

6. For an *Improvement in Railroad Car Wheels;* Thomas J. Eddy, Waterford, New York.

Claim.—"What I claim is, a cast iron car wheel, made in one piece, in which one end of the hub is united to the rim by means of a disk, and the other by means of a series of spokes, substantially as set forth."

7. For an *Improvement in a Paper Ruling Machine;* C. S. Boynton, City of New York.

Claim.—"I do not claim the endless apron, nor any particular manner of operating it, for they are now employed in ruling machines. But what I claim is, 1st, The employment or use of the guides, by which the paper may be properly adjusted upon the apron and fed underneath the pens. 2d, The guides or stops attached to the selvedge of the endless apron, for the purpose of elevating the pens from the paper at required distances, according as the guides or stops are adjusted upon the apron, and thereby causing the paper to be ruled in lines of the desired length, and having the requisite spaces between them, as described."

8. For an *Improvement in Submarine Tunnels;* Joseph R. Miller, Jersey City, New Jersey.

Claim.—"What I claim is, constructing submarine avenues, by casting them in short manageable sections, sinking each successively to its place, and uniting their ends successively by means of flanches, bolts, and packing, substantially as described, when these are combined with a lip or lips with the end of each section, to ensure the bolt holes and other corresponding parts to come and rest opposite to each other, as each succeeding section is sunk to its place, and when the structure is made to rest upon a graded bot-

tom, as the work progresses, and is held thereto, by superincumbent weight, when completed. I do not claim any one or any number of the elements above specified, except in combination with all the others; nor when used for any other purpose than that specified."

9. For an *Improvement in Temples for Looms;* Joseph A. Scholfield, Westerly, R. I.

Claim.—"What I claim is, the application of a stationary spur plate to the temple, with the pins in said plate inclined at an angle to the breast beam, so as to allow the cloth to be drawn over the tops of said pins, as the lay beats up, and from their inclination preventing the cloth from receding during the backward motion of the lay, in the manner and for the purpose described."

10. For an *Improvement in the Construction of Steam Boilers;* John M. Reeder, Memphis, Tennessee.

Claim.—"What I claim is, the application to steam boilers, of a stem, valves, and the mode of their operation, which will at any given pressure allow the water in the boilers to pass freely on the fire under them, thereby retaining the steam, and prevent explosion, as described."

11. For an *Improvement in Machines for Making Spikes;* John R. Richardson, James Waterman, and Ebenezer Wilder, New Castle, Pennsylvania.

Claim.—"We do not claim any peculiarity of the jaws, nor the manner in which the movable jaw is operated; for these are well known devices, and have been previously employed; but what we claim is, 1st, The manner of forming the point of the spike, substantially as herein shown and described, viz: by means of the combination of the wide dies resting on the disks of the rollers, and the pointing rollers, arranged and operating substantially as set forth. 2d, We claim slightly withdrawing the header, after the head is completed, for the purpose of relieving the jaws from its pressure, before they begin to open, and holding it in that position, with the spike head therein, until the jaws are opened and the movable jaw and die are nearly or quite withdrawn from the spike, then withdrawing the header to its farthest position from the dies, allowing the spike to fall; thus causing the header to perform the duty of a clearer, substantially as described. 3d, We claim the combination of the cutting guide loop, the cutter, and the holder, as constructed, and operating with the movable jaw and movable die, for the purpose of cutting off the blank at sufficient distance from the ends of the dies, to leave material for the head, and carrying it over to the stationary jaw, at the same operation, substantially as described. 4th, We also claim attaching the gauge firmly to the carriage of the pointing rollers, so that it will be withdrawn as the point is drawn out by the rollers, and returned to its position when the pointers are withdrawn, without any other mechanism to actuate it, as described."

12. For an *Improvement in Atmospheric Telegraph and Railway;* Ithiel S. Richardson, Boston, Massachusetts; patented in England, December 7, 1852.

Claim.—"What I claim is, 1st, The check plate, consisting of three pieces; two being stationary, and the third or middle one revolving between them, air tight, constructed as described, or in any manner substantially the same, and for the purpose set forth. 2d, The turn table, constructed as described, of the ring w, and its station box, in combination with the rings T and *v*, or their equivalents, as herein set forth. 3d, The method of announcing the arrival of the plunger, by means of the compression of the air within the cylinder, at the instant of the arrival of the plunger, operating through the orifice in the cylinder, the valve *g*, and the hammer *t*, as described, or in any other manner substantially equivalent thereto; the compressed air being the agent. 4th, And lastly, I claim the combination of the pendant lever x′, with the valve *f′*, and spring *o′*, or analogous devices, by which means the valve is drawn up to its seat, when no longer kept open, by the pressure of the atmosphere, and firmly locked in that position, until the lever is again tripped, by the passing plunger or load."

13. For an *Improvement in Printing Presses;* Stephen P. Ruggles, Boston, Massachusetts; ante-dated February 2, 1853.

Claim.—"What I claim is, the combination of the adjustable gauge with the diverging springs, for catching and guiding the edge of the sheet when it is sliding to its position, substantially as described."

14. For an *Improved Mode of Indicating the Height of Water in Steam Boilers;* Nathan Thompson, Jr., Williamsburgh, New York.

Claim.—"I wish it to be distinctly understood, that I do not claim either floats, or valves, or chambers, or levers, as of my invention, knowing that they are well known and common property; neither do I claim the combination of a float within a boiler, with indicators or alarms, in the general. But what I do claim is, the method substantially as herein described, of slowing and stopping the main engine, by means of a float, or its equivalent, which is governed, in its position, by the height of the water in the boiler; whereby I am enabled to furnish a reliable and not to be disregarded intimation of the level of the water in the boiler. Secondly, I claim a hook and pin, or their equivalents, in combination with a boiler float, whereby said float is prevented from acting during ordinary fluctuations of the water level, substantially in the manner and for the purposes herein specified."

15. For an *Improvement in Machinery for Making Railroad Chairs;* William Van Anden, Poughkeepsie, New York.

Claim.—"What I claim is, 1st, The combination of rollers with adjustable shear stocks for cutting and shaping the lips of wrought iron railroad chairs, substantially as set forth; and their combination with the dies for that purpose. I also claim the use of a movable drop upper half or female die, in combination with a stock, substantially as set forth, and their combination with the discharging apparatus, operated substantially as set forth. I also claim the use of adjustable and removable benders, in bender stocks, in combination with the levers and cams, on the main shaft, for operating the same, in an oblique and downward direction, and their combination with the dies and cutters, for making wrought iron railroad chairs."

16. For an *Improved Mode of Obviating the Danger from Steam Boiler Explosions;* Stephen Waterman, Williamsburgh, New York.

Claim.—"I do not confine myself to placing the cold water reservoir on the top of the safety chamber, as it may be placed in other positions; and instead of communicating with the safety chamber, may communicate with the steam space of the boiler. Nor do I confine myself to the particular mechanical means, by which the tearing apart of the safety plate is made to open the communications between the water reservoir and the boiler and safety chamber. But what I claim is, the combination with the safety chamber and safety plate of a cold water reservoir, which has means of communication at the lower part with the safety chamber or steam space in the boiler, and at the upper part with the steam space in the boiler; which said means of communication are closed when the boiler is in proper operation, by cocks, or their equivalents, which are caused to open by the tearing apart of the safety plate, in any manner substantially as described, for producing the effect herein fully set forth."

17. For an *Improved Arrangement of Pipes for Hot Blast Furnaces;* Jesse Young, Franklin Furnace, Ohio.

Claim.—"What I claim is, the arrangement of a series of angular, horizontal pipes, short vertical connecting pipes, which also serve as supports or pedestal, and a hollow base, through which the cold air passes into the pipes, and upon which hollow base the pipes rest, by which arrangement the air is made to pass slowly through the pipes and base, and is exposed a sufficient length of time to the action of the heat to become heated with a small expenditure of fuel."

18. For an *Improvement in Hot Air Engines;* Austin O. Willcox, Philadelphia, Pennsylvania.

Claim.—"I do not claim the use of renovating disks, outside of the working cylinder, either when alternately traveling through the heated and cold air, or when stationary, and alternately transmitting heated and cold air, as I am aware such have been before used. But what I do claim is, placing the economizing disks within or attaching them to the driving piston itself, whereby I am enabled to effect the complete rarefaction of the heated air, while the piston is descending, and before the cold air is again let into the cylinder, substantially in the manner and for the purposes herein described. I also claim enclosing the exhaust end of each single acting working cylinder, with an air-tight head, when combined with a self-acting valve, which opens from said exhaust end of the cylinder into the eduction pipe, in order to exclude the external atmosphere; and also for the double purpose of enabling any degree of rarefaction to take place within the exhaust end of the

cylinder, without the return of air from the reservoir, and to allow the spent air, finally, to escape to said reservoir, substantially as herein set forth. I also claim enclosing each working cylinder within a jacket, (of any suitable material,) regularly increasing in thicking, from the bottom to the top, in such a manner, that when it is surrounded by water, or other fluid, the temperature of the working cylinder will be kept reduced to a proper and nearly uniform degree, (without much waste of heat,) so as not to injure the lubricating fluid inside; whereby I am enabled to apply the heat of the furnace immediately under said cylinder, thus obviating the use of an expansion heater, substantially as herein described."

19. For an *Improvement in the Manufacture of Paper Stuff;* Jean Theodore Coupier and Marie Amedee Charles Mellier, Paris, France; patented in France, May 7, 1851.

Claim.—"We do not claim as our invention, the use of alkalies in the treatment of vegetable fibre for the preparation of paper pulp; nor do we claim the individual parts of the apparatus employed in our process; but what we do claim is, 1st, the process herein described, of reducing straw and other similar vegetable matters into pulp for making paper, said process consisting in applying and circulating the solution of the hydrate of soda or potash, in the manner above mentioned, and at or about the strength indicated, in combination with the apparatus, substantially as described, by which means we are enabled to effect the reduction of a very large amount of pulp, with a comparatively small quantity of liquor, and preserve, also, the requisite strength in the liquor, and also obtain facility for its evaporation. We do not claim the use of hypochlorites, for bleaching pulp; but what we do, secondly, claim is, the employment of hypochlorites in the process of bleaching straw, or similar vegetable matter, when prepared as above, for the purpose of making paper, substantially as herein set forth, that is to say, using them at or about the strength set forth in the specification, viz. 3° Baume, and we claim this degree of strength only when employed upon such materials."

20. For an *Improvement in Elastic Type for Printing on Irregular Surfaces;* Julius Herriet, City of New York, Assignor to J. Gaylord Wells, Hartford, Connecticut.

Claim.—"What I claim is, making by casting in moulds, or by pressure plates, with raised characters or figures, the entire substance of such plates being sufficiently elastic as to adapt it to printing, substantially as described."

21. For an *Improvement in Anti-Friction Boxes;* George T. Parry, Spring Garden, Assignor to John Rice, Philadelphia, Pennsylvania.

Claim.—"I do not claim as my invention the employment of conical rollers, traveling around in grooves, as a means of reducing friction on the ends of shafts, and under turning platforms, when the rollers are in the form of single frustrums; as this has long been known. But what I do claim is, making the rollers in the form of double frustrums reversed and united at their bases, and traveling in circular grooves of nearly corresponding form of the surfaces between which the rollers are interposed, substantially in the manner and for the purpose herein specified."

AUGUST 9.

22. For an *Improvement in Winnowers of Grain;* Samuel Canby, Ellicott's Mills, Md.

Claim.—"What I claim is, the construction of the receiving and discharging passages for the grain; that is, the passage at door, F, passage, C, and passage, C'', in the manner and for the purpose as set forth."

23. For an *Improvement in Multiplying Gearing;* Frank Dibben and Lewis Bollman, City of New York.

"The nature of this invention consists in transmitting rotary motion by means of the difference of proportion between two pairs of toothed wheels, or their equivalents, two of the wheels, viz: one of each pair having a common fixed axis, and the other two wheels gearing into them having a common axis which is capable of revolving round the said fixed axis. By the difference of proportion between the two pairs of wheels, we mean the difference between the proportion that the circumference of the two wheels of one pair bear to each other, and the proportion that the circumference of the two wheels of the other pair bear to each other."

Claim.—"What I claim is, the employment in any manner substantially as described for the purpose of transmitting rotary motion, at a multiplied or decreased speed, of two pairs of toothed or friction wheels, combined and arranged as described, to wit; the said wheels being placed upon two axes, one of which is capable of revolving round the other;

one wheel of each pair being on the axis *e*, and the other wheel of each pair being placed upon the axis *f*, as herein set forth."

24. For an *Improvement in Life Boats;* Daniel Dodge, City of New York, and Phineas Burgess, East Boston, Massachusetts.

Claim.—"We do not claim to have invented a boat having an opening extending completely through it, whereby it is rendered, by the addition of a floor, fit for service in opposite positions on the water; but what we do claim is, the central fixed platform, which is secured in the opening of the boat, in a plane passing centrally and horizontally, or nearly so, through the same, or which may be said to form a partition between two opposite recesses, substantially as described, the said platform serving as a floor to the boat, whichever side is upwards, and being from its fixed position, incapable of becoming disarranged by any accident."

25. For an *Improvement in Setting up Ten Pins and Returning Balls;* George W. Eichell, City of New York.

Claim.—"I do not claim the elevator *n*, nor any particular elevator; neither do I claim setting up the pins by a weight or weights; nor do I intend to claim the setting up of the pins from the head of the table; but what I do claim is, setting up the pins of an alley by an apparatus, operated from the head of the table or elsewhere, by means of a weight or weights attached to them by cords, when combined with the elevation board, which raises and sustains the weight or weights, to admit of the pins being knocked down, as herein described. I also claim the use at the back end of the table of a delivery board, applied and constructed as described, in combination with an elevator for the elevation and return of the balls, substantially as described."

26. For an *Improvement in Carpenter's Clamps;* Benjamin H. Green, Princeton, New Jersey.

Claim.—"What I claim is, the combination of the adjustable vibratory arms, and reversible jaws, with the adjustable clamp, for the purpose of presenting jaws of different sizes and at different distances from each other, substantially in the manner herein set forth."

27. For an *Improved Mode of Drying Paper;* John Hartin, City of New York.

Claim.—"What I claim is, drying paper by passing it between opposite series of equal sized fans, which revolve with equal velocities; by which a pressure of air of equal force is made to act simultaneously upon opposite sides of the paper, and thereby insure smooth and uniform surfaces upon the same, substantially as set forth."

28. For an *Improvement in Railroad Car Seats;* Samuel Hickock, Buffalo, New York.

"My invention consists in the manner or method of constructing these seats, so that they can be easily changed in either direction, and converted from a position to sit upright to that of a reclining seat, and vice versa, so as to serve well the purpose of either a day or night seat, without increasing the space which they occupy over those of ordinary construction, whereby great convenience and comfort is attained for weary travelers."

Claim.—"What I claim is, constructing a railroad car seat, by connecting and arranging the sliding seat with the revertible back, hinged at the extremity of the reversing arms, and combining therewith the double ratchet bars, in such a manner that it can be easily converted in either direction into a day or night seat, and at the same time not occupy more space than the ordinary stationary seat, substantially as set forth. I also claim the triangular foot rest in combination with the sliding seat, whereby it is made adaptable to the seat when used either as a day or night seat, substantially as set forth."

29. For an *Improvement in Winnowers;* Lewis S. Ingraham, Cuyahoga Falls, Ohio.

"The nature of my invention consists in making the screen or screens stair shaped or fluted, and vibrating them perpendicularly or diagonally, instead of traversing or shaking them horizontally as heretofore, so that the grain falls successively from one stair or flute to the next, until it passes over all the stairs or flutes in the screen; also, in using it in combination with a plain screen, which may be used either before or after the stair screen, as may be preferred."

Claim.—"What I claim is, the stair or fluted screen, constructed and operated substantially as described for the purposes set forth."

30. For an *Improvement in Iron Posts for Fences;* John W. Jenkins, Greenport, New York.

Claim.—"What I claim is, the arrow headed or barbed bottom of the post in combination with the twisted cross piece, substantially in the manner and for the purpose set forth."

31. For an *Improvement in Fire Arms;* George Leonard, Shrewsbury, Massachusetts.

Claim.—"What I claim is, a revolving fire guide, which by the continued operation of the fire arm, shall successively communicate fire to the different charges of several barrels."

32. For an *Improvement in Printing Presses;* John Lewis, Buffalo, New York.

"The nature of my invention consists of a swinging bail or pressure bail, in combination with the lever power, in such a manner as to bring the power upon the centre of the platen by one motion of the lever."

Claim.—"What I claim is, the swinging bail and the pressure bail, constructed and operated substantially as set forth."

33. For an *Improvement in Corn Shellers;* Eben L. Millis, Rochester Depot, Ohio.

Claim.—"What I claim is, reducing the larger ears of corn to be shelled, to a nearly uniform size with the smaller ones, by passing the whole through between a toothed cylinder and concave, where the large ears are caught and partially reduced or operated upon, preparatory to their passing with the smaller ones through between a second cylinder and concave, where the entire operation of shelling and separating takes place, the whole being performed substantially in the manner herein described."

34. For an *Improvement in Printing Presses;* Joel G. Northrup, Syracuse, New York.

"The nature of my invention consists in combining with a vibrating bed, a series of intermittingly rotating platens, so that the sheets may be placed on the platen in the most convenient manner, and fall from the platen after receiving the impression, without the necessity of requiring a delivery apparatus, and by which construction I produce a very cheap and very effective press."

Claim.—"What I claim is, the combination of the series of intermittingly rotating platens with a vibrating bed, when so arranged as that the delivery of the printed sheet is from the lower of the series of platens, so that it may drop from the platen on to the paper table, or into a drawer, substantially as described."

35. For an *Improvement in Friction Rollers;* James Patterson, Franklinville, N. York.

"The nature of my invention consists in arranging, within a central aperture of the car wheel, and around its axle, a series of anti-friction rollers, each of which has bearing portions of different diameters, the larger of which roll upon the inner periphery of the car wheel, and the smaller upon an enlarged portion of the axle; their proportions may be such that the inner circumference of the wheel shall bear the same ratio to that of the larger portions of each roller as the circumference of the enlarged portion of the axle bears to that of the smaller portion of each of the rollers."

Claim.—"What I claim is, fitting the bearing of a rolling car wheel on a fixed axle, with a series of friction rollers, having bearings of large diameter to run in contact with the axle, the latter being enlarged at the point of contact with the rollers, as specified."

36. For an *Improvement in Rolling Railroad and other Iron;* Alfred B. Seymour, Hudson, New York.

"My invention is intended for rolling railroad and other bars which require repeated rollings to complete them, with the view to save labor in handling the bars, and to expedite the rolling, and to avoid or reduce the number of reheatings."

Claim.—"I do not wish to limit myself to the modes of application herein specified, as other modes of applying the principle of my invention, either superior or inferior, may be devised. Nor do I wish to limit myself to any particular manner of communicating the driving power to the series of rollers, as any equivalent mode may be substituted, or some better mode may be devised. I do not claim as my invention the employment of a series of draw rollers to act in succession on a bar of iron or other metal, to draw it into a required form, as this has long since been devised and tried; but what I claim is, the employment of a series of pairs of rollers, so arranged that the pairs in the series shall be free to move from or towards each other, to adapt themselves to the condition of the metal in the process of rolling, substantially as and for the purpose specified."

37. **For an** *Improvement in Repeating Fire Arms;* Joshua Stevens, Assignor to the Massachusetts Arms Company, Chicopee, Massachusetts.

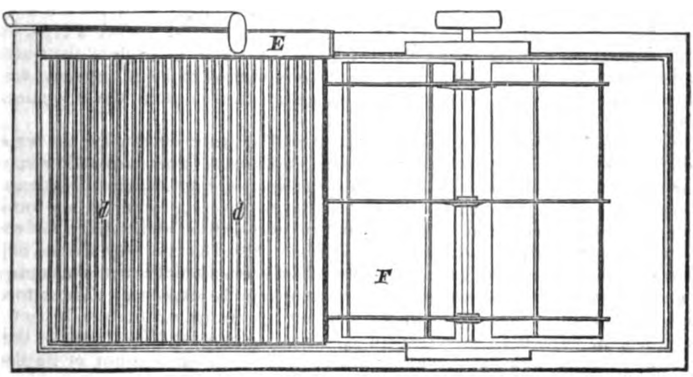
Claim.—"What I claim is, to so construct and combine together, substantially as described, the lock, trigger, and mechanism for rotating, and locking and unlocking the chambered cylinder, as that while by a simple pull of the trigger, the operations of unlocking and rotating the magazine or chambered cylinder, relocking it, and discharging the cock, shall be caused to take place by power applied to the trigger alone, the elevation of the cock, or the cocking of it, shall be previously effected by the hand of a person, or means entirely separate from the trigger, as described. And I also claim the combination of the stirrup, the spring bolt, and the lever, arranged and made to operate together, substantially as specified. I also claim the combination of the sectoral plate, (made as described,) with the spring bolt and its slot, the said plate being applied and made to operate essentially as explained. I also claim the method above set forth, of constructing the lever, viz: of two parts, (turning on one common pin,) in combination with their confining and adjusting screws; the whole being substantially in manner and for the purpose above described."

Specification of a Patent granted to B. H. Bartol, of Philadelphia, Pennsylvania, for an ***Improvement in Refrigerators for Cooling Water used in the Condensation of Vapor from the Vacuum Pans in the Manufacture of Sugar—and for the Condensation of Steam in Steam Engines;*** dated June 28, 1853.

"The nature of my improvement consists in an improved apparatus for cooling water used for the condensation of vapor from vacuum pans in the manufacture of sugar, or for the condensation of steam in steam engines. The improvement is particularly applicable in those sections of country where water is scarce, as by means of this improvement the same water may be employed for condensation, then cooled, and again employed any number of times in succession.

"A is a room 12 feet square, and not less than 10 feet high; this room is filled with a series of vertical board partitions, *b b*, the boards being rough, or corrugated with horizontal seams. Between the partitions there are passages, c c, of about 2 inches wide; at the top of the room, about two inches above the partitions, and in line with them, are a range of horizontal pipes, *d d*. These pipes open into a tank, E, containing the water to

Fig. 1.

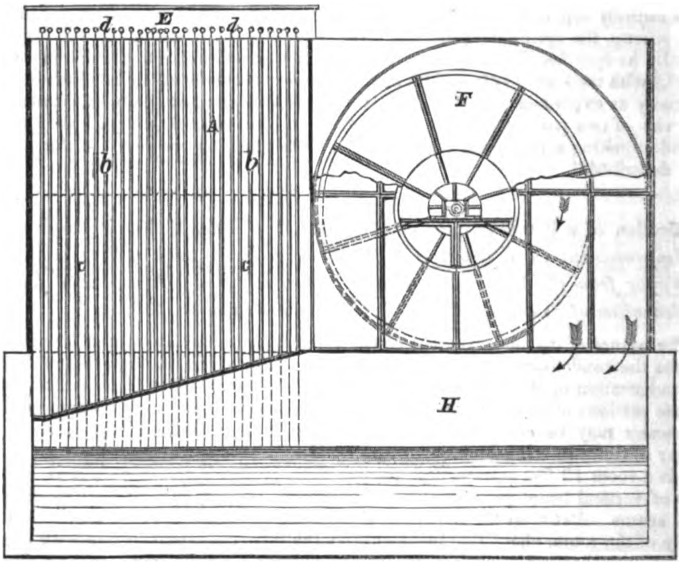


Plan View.

be cooled. These pipes have a row of fine holes along their lower side for the escape of the water. The water then passes directly on to and slowly trickles down the board partitions. The upper edges of these partitions are sharp, so as to divide the water and cause it to pass equally over both sides of the partition. F is an ordinary centrifugal or rotary fan blower, discharging its air into the upper part of the cistern, H. This cistern, H, is entirely closed, except at the interstices between the board partitions, *c c c*.

"The operation of my improved refrigerator is as follows:—The water to be cooled is pumped by any ordinary means into the tank, E. From this tank it flows through the pipes, *d d*, and escapes through the series of holes in their lower side, trickles slowly in very thin streams down the rough or corrugated surface of the boards, *b b*, and finally discharges from the lower end of the boards into the cistern, H. The air discharged by the fan blower, F, is forced to pass from the cistern up through the interstices, *c c*, as

Fig. 2.



Longitudinal Vertical Section.

shown by the arrows, and then escapes between the pipes, *d d*, above. This air is divided into currents by the partitions, and is forced to pass in close proximity to the attenuated streams of water trickling down along the surface of the boards. Hence a rapid evaporation and consequent cooling of the water results. A single passage of the water down the partitions cools it sufficiently. The boards, *b b*, instead of being arranged vertically, as indicated in the drawing, may be placed in an inclined position, the interstices being preserved.

"Heretofore, fan blowers have been applied to cooling water by causing the water to be dropped from an elevated tower through an ascending current of air from a blower; but that mode is objectionable, inasmuch as the size of the drops are not sufficiently attenuated to be thoroughly cooled. Second, the contact of the air with the water is not sufficiently intimate, much air passing out without producing evaporation; and, thirdly, the construction of towers of considerable elevation is required. The last is a very serious objection, on account of the trouble and expense involved in the erection of towers on sugar plantations, and in situations in which refrigerators are generally employed. These towers are required to be about 40 feet high; whereas, by my apparatus, a structure 10 feet high is amply sufficient. Moreover, it will be readily seen that at least 75 per cent. of the power required to raise the water to the upper reservoir, is saved on account of its decreased elevation. By my improvement, therefore, the expensive construction of tower is dispensed with, and a much more complete and economical cooling of the water is effected.

"I do not desire to claim the application of the current of air of a fan blower to cool water; but what I desire to claim and secure by Letters Patent is, the arrangement of the series of partitions and interstices for cooling water, in the manner and for the purpose substantially as herein set forth."

MECHANICS, PHYSICS, AND CHEMISTRY.

For the Journal of the Franklin Institute.

Remarks on Captain Ericsson's Caloric Engine.

Several of the recent numbers of *Appleton's Magazine* have contained articles for and against the caloric engiue of Capt. Ericsson. Maj. Barnard, of the U. S. Engineers, having demonstrated, theoretically, that the whole thing is based upon erroneous suppositions, which cannot possibly be true, Capt. Ericsson replies, and demonstrates in *his way*, that the engines in the ship *Ericsson* possess a power of more than 1200 horses, subject to such deductions for friction, &c., as practice may determine to be correct. Without examining into the correctness of the data used by either of the above gentlemen, it must strike an ordinary observer that while the arguments of Capt. Ericsson are plausible, those of Maj. Barnard are more in accordance with the facts. Capt. E. attributes the failure to the weakness of her cylinder bottoms, which are the tops or crowns of her furnaces; he is correct if he means by this to say that during the trip to Washington, the cylinder bottoms became so far injured as to be useless for further operations, and I have reason to suppose that they were fractured on the second trial trip; but on the first he makes no complaints; every thing is all right, and the vessel comes up to the expectation of himself and friends. The days of steam are numbered, and the newspapers of the next day proclaim to the world the entire success of the ship; and yet, at this time, the useful effect of the engines was but about 250 horses power, being only 20 per cent. of the amount Capt. E. claims, subject to the deductions before stated. Now, I am quite certain that at no time did the engines of the *Ericsson* come up to the expectations of Capt. E., for one of the first things done after the first trial, at the dock at Williamsburg, was to reduce her wheels, (which were not beyond the ordinary size); thus, at the very outset, virtually admitting a deficiency of power where he expected an abundance. Capt. E. has now abandoned his former engines, and is putting in those which have much smaller parts, intending to use compressed air, (and skeptics do say that he intends to use a steam engine to compress the air and make up for the waste)

Maj. Barnard has been writing to prove that the engines were deficient in power, because based on wrong principles. Capt. E. defends the principle, but admits their failure by taking them out of the ship, although as yet, he does not confess the fact to the public. It must be remembered that Capt. E. has never put one of his engines successfully at work; his model engine, reputed at 60 horse power, has remained almost entirely inactive for the past eighteen months. By using it in the works of Messrs. Hogg & Delamater, (who manufacture all his machinery,) he would have confused his enemies and comforted his friends. Hogg & Delamater, although active friends of Capt. E., still persist in using an ordinary high pressure engine to drive the machinery at their works, while they are almost exclusively occupied in the construction of caloric engines; but unfortunately, as yet, none of them have ever been finished,

(except the one for the *Evening Post*, which was sent to France.) Capt. E. may now write volumes in regard to the theory of his engine, and not produce the least impression; but if he wishes to convince, he has only to put one of his engines *at work*, and invite those competent to judge, to examine it and report, and he will do more in one week (if successful) to establish his fame, than by years of mysterious movements, however well supported by kind friends, who, at a later period, must condemn the same policy they now approve. True science should never seek the dark, but soar on eagle's wings.

WATT.

Separation of Gold from Arsenical Pyrites, according to Plattner's Method. By W. GUETTLER.*

The mines of Reichenstein, in Silesia, abandoned for more than five centuries, have been recently opened with advantage, in consequence of the application, on a large scale, of a method invented by Professer Plattner, for separating gold from the waste of arsenical ores.

The ore at Reichenstein is an arsenical pyrites, containing about 200 grains of gold in the ton. The ore is roasted in a reverberatory furnace surmounted by a large condensing chamber, in which the arsenious acid is condensed as fast as it is volatilized. There then remains on the floor of the furnace, oxide of iron mixed with a certain quantity of arsenic, together with the whole of the gold. This is placed in a vessel so arranged that a current of chlorine can be passed through it, by which the gold and iron are taken up, and afterwards separated from the residuum, by the aid of a certain quantity of water, and the gold is afterwards precipitated from this solution by sulphuretted hydrogen. To prevent the admixture of iron at this stage, a small dose of hydrochloric acid is added to the solution before the sulphuretted hydrogen is introduced. The auriferous compound having been separated from the liquor, is washed and heated in an open porcelain crucible, to drive off the sulphur, by which the gold is reduced to the metallic state by fluxing it in the usual manner.

This simple and ingenious method, which has made it worth while to re-open the Reichenstein mine, is equally applicable to the vast quantity of refuse accumulated near many other old works. In awarding the Council Medal, the Jury have desired in this case to associate the name of Professor Plattner, the inventor of the method, with that of M. Guettler, who has brought it into operation on a large scale.

Translated for the Journal of the Franklin Institute.

Method of Raising Heavy Weights under Water.

From a recent number of *Cosmos*, an admirable weekly scientific periodical, edited in Paris by the Abbé Moigno, best known perhaps, in this country, by his excellent work on electric telegraphs, we extract the following account of a recent experiment:—"On Saturday last, Doctor

*From the Reports of the Juries of the Exhibition of the Works of Industry of all Nations, 1851. London.

Gianetti, inspecting physician of the waters of Verdese, (Corsica,) invited us to be present at an experiment, at the same time very curious and very important, on the margin of the Seine, near the bridge *des Arts.* The object was, by means of a small balloon of about a foot and a half in diameter suddenly inflated at the bottom of the water, to lift to the surface a weight of one hundred kilogrammes, (225 lbs.) The *modus operandi* of the Doctor is very rational and very simple; he caused to be constructed in very stout metal, a vessel with two compartments and three tubulures; by two of these tubulures he pours into one compartment, bicarbonate of soda, into the other, hydrochloric acid; on the third tubulure he screws the balloon of leather, or some very strong impermeable stuff. In the experiment at which we were present, the vessel with the balloon was fixed to the ring which united the four weights of 25 killogrammes, (56 lbs.,) before the weights were lowered into the water, and workmen lowered the whole to the bottom of the river. A thin cord which Mr. Gianetti held in his hand, had been fixed to a small arm of a lever upon the vessel; by pulling it he opened a stop-cock, and established a communication between the two compartments of the vessel, so as to mix the two liquids; the acid and salt reacting upon each other produce a very abundant disengagement of carbonic acid; immediately the balloon became inflated, developing a considerable ascensional force, and we saw it rise to the surface, bringing with it the four weights.

Remarks.—We cannot say that there is anything of value in this, beyond the well known and long applied principle in use in our floating docks and camels, where caissons filled with water are first sunk and placed around the mass to be raised, and then the water being replaced by air, by means of pumps, the whole body rises in the water; but it is possible that M. Gianetti's method of replacing the water by gas may be available in some cases where the other, less expensive and more effectual method could not be applied. Ed.

Translated for the Journal of the Franklin Institute.

Experiments on the Undulatory Theory of Light.

In a former number of our *Journal*, we have brought to the notice of our readers the extremely ingenious and delicate experiment by which M. Foucault, of Paris, confirmed the undulatory theory of light, and demonstrated the falsity of the emission hypothesis. The following article, which we translate from the pages of the Abbé Moigno's *Cosmos*, furnishes another no less extraordinary confirmation of the same theory by the application of extreme mechanical nicety:

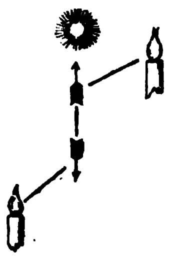
"M. Nobert, a German optician, has succeeded in tracing upon a surface of polished glass, perfectly parallel lines, the distance of which apart is only the five-thousandth of a millimetre, (0·000008 inch,) the length of a wave of light, and has desired to make his marvellous skill subserve the triumph of the undulation theory. For this purpose he has executed three plates, which we did not wish to describe until we had seen them

ourselves. They were sent to us by M. Albert, of Francfort, only a few days ago. We immediately appealed to the zeal and optical resources of M. Jules Duboscq, to the skill of M. Nachet, and perfection of his microscopes; with the German instructions in our hand, we repeated the fundamental experiments; they fully satisfied us; we were convinced that the plates of M. Nobert were the true touchstone of the optical theories, and we recommend them to all physicists as a charming and good thing.

First Plate.—In the centre of a quadrangular strip of glass are traced seven groups of equi-distant parallel lines; the lines of each group are equally spaced; the different groups are separated from each other by a greater interval; in passing from one group to another, the distance of the lines apart augments, and the seven distances are proportional to the wave-lengths of the seven principal colors of the spectrum; *violet*, *indigo*, *blue*, *green*, *yellow*, *orange*, *red;* the following are the distances expressed in millionths of a Parisian line: 1st group, *violet*, 900; 2d, *indigo*, 1000; 3d, *light blue*, 1075; 4th, *green*, 1188; 5th, *yellow*, 1325; 6th, *orange*, 1450; 7th, *deep red*, 1600.

When these seven groups have been traced upon the plate, it is covered with a very thin protecting slip with parallel faces, and there is engraved upon this slip with the point of a diamond, a star, a double arrow, and a double candle with its flame, as is shown in the accompanying figure.

Fig. 1.



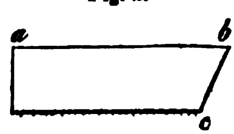
To observe, we take a microscope magnifying from 16 to 27 times; if the lenses have not, like those of the French microscopes, a very small diameter, a small disk of blackened metal pierced with a small hole, is placed in the mounting of the objective; the plate is placed on the table of the microscope, with the arrow pointed towards the light (the best of all lights is that from a white cloud); between the mirror and the light is erected, five or six inches from the mirror, a screen pierced with a horizontal slit six inches long and one-third of an inch wide, which throws the light upon the side of the mirror corresponding to the flame engraved upon the plate; while looking through the eye-piece, the mirror is gently turned, and soon seven colored bands or seven flat or uniform tints appear in the field of vision, representing the seven principal colors of the solar spectrum, separated by dark very distinct and very brilliant intervals. The plate may be placed in two different ways on the table of the microscope; with the protecting plate either above or below. In the first position, the interferences which produce the colors, evidently take place in the sheet of air between the plate and its cover, and the spectrum produced may then be called the air spectrum; in the second position, the interferences take place in the glass, and the spectrum is the glass spectrum. Now, observation shows that these two spectra are completely identical, that the colors are exactly the same, as they ought to be according to the theory of undulations, which thus receives a simple and striking confirmation. Let us enter upon a short explanation on this subject: if everything has been arranged as we have said, the luminous ray falling upon the groups of lines will make, (and this is the normal condition of M. Nobert's experiment,) with the perpendicular to the plate,

an angle of 11° 24′. Then, if we call d the distance of two of the equidistant lines in any one of the groups, λ the wave-length corresponding to the color which this group gives, we ought to have $\lambda = d.\ \sin.\ 11° 24'$. And in fact, if we consider for example, the indigo group for which $d = 0{\cdot}0001$, we have $0{\cdot}0001 \times \sin.\ 11° 24' = 0{\cdot}000197$, and 197-millionths of a line is, in truth, the wave-length of the indigo ray. Besides, every observer, by unscrewing his objective lens magnifying from 15 to 20 times, and replacing it by a system of lenses magnifying from 180 to 200 times, will see the parallel lines of each group clearly separated; he may measure their relative distance, d, calculate the seven products, d, $\sin.\ 11° 24'$, which will give him the seven known wave-lengths of the seven principal colors of the solar spectrum.

But, if the covering plate be below, the angle of incidence, i, becomes the angle of refraction r, determined by the equation $\sin.\ i = n.\ \sin.\ r$, n being the index of refraction for glass; it is thus an angle which has for its sine $\frac{\sin.\ i}{n}$. If, then, we call λ' the wave-length, in glass of the color given by the observed group, we shall have $d = \frac{\lambda'}{\sin.\ r} = \frac{\lambda' n}{\sin.\ i}$. Observation proves that the color after turning the plate, remains the same; we shall then have $\lambda = \lambda' n$, or $\lambda' = \frac{\lambda}{n}$; consequently, the wave lengths in glass are shortened, as the undulatory theory requires in the ratio of $\frac{1}{n}$, of unity to the index of refraction. It is, besides, a first principle in this theory, that, 1st, the time t of the luminous vibrations cannot change from one medium to another; 2d, that the velocity of propagation in a given medium is measured by the ratio of the wave-length λ, to the time t, of the oscillations; if, then, we call v and v' the velocity of light in air and in glass, we shall have $v = \frac{\lambda}{t}$, $v' = \frac{\lambda'}{t}$ and, consequently, $\frac{v}{v'} = \frac{\lambda}{\lambda'} = n$. Thus, the same very simple experiment, made with Nobert's plate, which proves that in glass the wave-lengths are less than in air, in the ratio of $\frac{1}{n}$, proves also that the velocity of light in glass is smaller than that in air, in the ratio of unity to the index of refraction. In the double point of view of elegance and simplicity, the experiment of M. Nobert is altogether comparable with that of M. Arago, who showed the retardation of velocity in the most refracting medium, by the displacement of the interference fringes, and in these regards, much surpass those of M. Foucault.

Second Plate.—On the face $a\ b$ of a plate of glass two lines thick, twenty lines long, and ten lines broad, of which the second face, $b\ c$, highly polished, makes, with the face, $a\ b$, an angle of about 75°, are traced parallel to the length, and very near the acute angle $a\ b\ c$, a series of fifteen groups of parallel lines, designated by the letters of the alphabet from A to P, and such that the distances d_a, d_b, d_c, &c., are

Fig. 2.



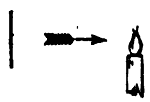
exactly represented in millionths of a Paris line by the following numbers:

A, $d_a = 400$; B, $d_b = 350$; C, $d_c = 300$; D, $d_d = 275$; E, $d_e = 250$; F, $d_f = 237$; G, $d_g = 225$; H, $d_h = 212$; I, $d_i = 200$; K, $d_k = 188$; L, $d_l = 175$; M, $d_m = 163$; N, $d_n = 150$; O, $d_o = 138$; P, $d_p = 125$.

The divisions are also covered by a protecting slip of glass, on which are engraved, as indicated in the subjoined figure, a slit, an arrow, and a candle.

To observe with this plate, a microscope magnifying from 40 to 50 times, must be employed; it is absolutely necessary to close all access for the light coming from below, and for this purpose, the mirror is covered with a thick coating of black stuff, velvet for instance; the lens is diaphragmed, as in the foregoing experiment; the plate is placed upon the horizontal table of the microscope, at first with its cover above, turning the polished face, *b c*, towards the light. The light, that of a white cloud for instance, is made to fall upon the divisions under an angle of about 20° 20′ with the plane of the lines; we look through the eye-piece, and when the vertical plane of illumination is perpendicular to the lines of the divisions, we see fifteen colored bands appear, the tints and wave-lengths of which, calculated by means of the formula $\lambda = d$, cos. 20° 20′, are given in the first column of the following table, always expressed in millionths of a line.

Fig. 3.



So far the interferences which give rise to the colors, are produced in the stratum of air included between the ruled plate and its cover; but if we invert the plate, placing the cover below, leaving always the polished angular face turned towards the source of the light, we will see fifteen new colored bands, the tints and wave-lengths of which, calculated by means of the formula, $\lambda' = d$, cos. 20° 20′ (supposing that the illuminating ray has kept the same direction,) are given in the second column of the table.

Interferences in the Air.		*Interferences in the Glass.*	
A, violet,		A, red,	
B, deep red,	$\lambda = 328$	B, burnt yellow, (*jaune brulé*),	
C, light orange,	= 281	C, green,	
D, sulphur yellow,	= 258	D, indigo,	
E, beautiful green,	= 234	E, violet,	
F, greenish blue,	= 223	F, violet red,	
G, blue,	= 211	G, gray,	
H, indigo,	= 199	H, red,	$\lambda' = 199$
I, violet	= 187	I, red,	= 188
K, very deep violet,	= 175	K, orange,	= 177
L, dark grey,		L, burnt yellow,	= 165
M, "		M, yellowish green,	= 153
N, "		N, green,	= 141
O, "		O, indigo,	= 130
P, "		P, violet red,	= 118

Let us point out rapidly the consequences which may be drawn from the foregoing observations:

1st, In the air spectrum, the five groups, L, M, N, O, P, when we are

very careful to remove every extraneous light give no color, and this is again a striking confirmation of the undulating theory, according to which the interference colors disappear so soon as the product *d. cos* 20° 20′ is less than the wave-length of the luminous rays in the air.

2d, In the first position of the plate, the groups B, D, I, give respectively, red, yellow, and violet; in the second position it is the groups H, L, P, which give nearly the same red, the same yellow, and the same violet, &c. If the undulating theory is true, the intervals of these last three groups must be smaller than those of the former in the ratio of unity to the index of refraction of glass; and, in fact, if we calculate the three ratios $\frac{d_b}{d_h}$, $\frac{d_d}{d_l}$ and $\frac{d_i}{d_h}$, we shall obtain numbers sensibly equal to 1·525 the coefficient of refraction of the glass of the plate.

3d, The wave-length corresponding to the color of the group B, seen in the air, proves that there exist towards the red extremity of the spectrum colored rays having a wave-length greater than those which have hitherto been measured; and this fact should surprise us the less, since M. Brewster and Mathiessen have proved that the extreme red extends far beyond the limit which was assigned to it. Fraunhofer, moreover, measured the wave-lengths only for the waves included between the fixed lines B and H. According to M. Herschel, the wave-length of the extreme red is 0·000312, and M. Nobert's has for its wave-length, 0·000328; according to M. Herschel, moreover, the wave-length of the extreme violet is 0·0002, and M. Nobert's plate descends to 0·000175.

4th, Several of the colors given by the plate are the octaves of each other, or are, one of the first, the other of the second order; the red of A and that of I, the yellows of B and of L, the greens of C and of N, the indigoes of D and of O, are in this condition, their wave-lengths are in the ratio of one to two.

To give an idea of the difficulties which M. Nobert has had to overcome, to succeed in tracing these groups with certainty, we will remark that it is necessary not only that the lines of each group shall be perfectly equi-distant, but that from one group to another these distances should vary by quantities which are really infinitely small. Thus the difference $d_n - d_o$ between the distances of two contiguous lines in the groups N and O, is only $\frac{12}{1\cdot000\cdot000}$ths of a line, or a little more than $\frac{1}{100\,000}$ths line, and this distance is sufficient to cause the color to pass visibly from green to indigo; the lines of M. Nobert are therefore accurate to nearly one-millionth of a line. The tenth group already escapes from the power of almost all microscopes known; that is, their highest magnifying powers do not permit us to separate clearly, and to count the lines of group O, and the groups below it. M. Nobert himself has constructed microscopes which separate not only the lines of these five groups, but lines still more close, the distance of which is only $\frac{1}{8000}$ of a line, and permit us to perceive the real, but confused separation of lines distant from each other $\frac{1}{8000}$ of a line.

Third Plate, Colored line Micrometer.—Upon a thin plate of English glass, highly reflecting, very transparent, but slightly absorbent, have been engraved five groups of equi-distant parallel lines. The distance

between two contiguous lines of each group is $\frac{325}{1000000}$ths of a line; the breadth of each group is $\frac{1}{300}$th of a line; that is, the thickness of one of the threads used in an ordinary micrometer; the intervals between the groups are such that a star situated in the equator, and looked at through the micrometer placed in a telescope, will require fifteen seconds to pass from one group to another. The micrometric plate, placed as we have described, is illuminated obliquely by the ray of a lamp or gas burner, penetrating through an opening in the eye-piece tube, at a small distance from it. The lamp or illuminating object is placed upon a movable arm, carrying besides, a vertical screen with a longitudinal slit, and turning around its axis provided with a graduated circle, so that the luminous rays may fall on the micrometrical plate under any inclination from 0° to 90°, and so that at any moment the angle of incidence or the angle of the ray with the plane of the groups can be read off upon the circle. This being supposed, if the ray makes, with the plane of the groups, an angle of 15°, or with the perpendicular to the micrometric plate, that is, with the axis of the telescope, an angle of 75°, the five groups will give rise to five lines of red light, which will be replaced by five lines of another color if the movable arm is turned; these colors may consequently pass by degrees through all the tints of the solar spectrum; so that a color being given, we may always find a position of the movable arm, which colors the groups with the same tint.

As long as the incidence of the ray, or the position of the movable arm remains fixed, the micrometric plate behaves like the ordinary micrometer with illuminated lines; it also replaces the glass plate which in M. Lamont's method receives the images of the illuminated lines outside of the eye tube. As the colored bands can be seen as well through the object glass as through the eye-piece, the new micronometer may be used with great ease and certainty, either for the determination of the nadir according to the method of Bessel, or for fixing the position of the zenith according to the process of M. Faye. But the application which pleases M. Nobert the most is, the use which may be made of his plate for determining in a precise manner, the constant or variable colors of the stars. In truth, from the very fact that by turning the movable arm, or varying the angle of incidence of the ray, we may always color the bands with the tint of the star seen in the interval between the groups, the personal errors of the observer will be completely eliminated, and moreover, the color of the star may be immediately expressed in numbers. In fact, if we call λ the wave-length, d the distance of two contiguous lines, i the angle of incidence of the ray, we shall have $\lambda = d, \cos i$.

The plate will not only be a *chromatometer*, it may also serve as a photometer; for, by varying the length of the arm without changing its direction, that is, by increasing or diminishing the distance of the illuminating body from the plate, we augment or diminish the brilliancy of the bands; they may thus always be brought to have the same degree of brightness as the images of the stars whose relative intensity of light may be thus determined. To make these latter observations easier, M. Nobert purposes to replace he plate with seven groups by a plate with but a single group, but much arger, formed, for instance, of 80 or 100 parallel equi-distant lines, to observe the stars, not in focus, but without it, as in the photometer of Steinheil, so as to give their images a certain diameter; then, after having produced

the similarity of tint, to bring them to equal intensity by opening or closing the parallel slit through which the rays pass. Since, as we have said, the wave-length of the light of the star can be calculated, we shall have not only its relative brilliancy, but also its specific brightness deduced from the breadth of the oscillations.

M. Nobert has undertaken to make actual observations in this new direction; we shall report them as soon as they are published.

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*Launch of the Steamship Himalaya.**

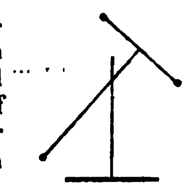
On Tuesday last, the launch of the largest ship in the world—the huge *Himalaya*, built by Messrs. Mare and Son, for the Peninsular and Oriental Steam-Packet Company, took place. Her length aloft is 340 feet, and at the keel 311 feet; depth of hold, 34 ft. 9 in., and burthen 3550 tons, being considerably more than the *Great Britain*, once the great nautical wonder of the world. The engines are equal to 700 horses power, and are expected to drive her at a rate of from 12 to 14 miles per hour. The *Himalaya* was intended originally for paddles, but subsequently was adapted to the screw. The engines are in course of construction at Messrs. Penn's. The *Himalaya* is to have an entire outfit of Trotman's patent anchors; the two bower anchors will be 48 to 50 cwt. in weight, whereas anchors of the old description would have reached five or six tons. She will have accommodation for 400 cabin passengers, 500 tons of measurement goods, and 1200 tons of coal.

On the Mechanical Imitation of Precession. By the Rev. Prof. Powell, F. R. S., &c.†

The actual mechanical exhibition of the composition of rotary motion giving the physical explanation of the Precession of the Equinoxes has been attempted by more than one contrivance.

In the *Astronomical Notices*, vol. i. p. 43, appears a description of a machine of this kind by Mr. Atkinson, but so brief that it is difficult to collect what the principle of it was. It is also understood that another instrument was constructed by the Astronomer Royal; but of this it does not appear that any description has been published.

In the present instance, before the author was aware of either of these contrivances, he had constructed one which he believes exhibits the essential mechanical principle with greater simplicity than any previously devised.



It consists merely of a bar (loaded at its ends) capable of rotating freely about one end of an axis, which itself can turn about a point in its length, near the end carrying the bar, upon an horizontal axis capable of moving in azimuth round a vertical pillar. At the lower end of the first axis is a weight, which *rather more* than counterpoises the upper part; and when there is no rotation in the bar, simply brings the first axis down into a vertical position.

* From the Journal of the Society of Arts, London, No. 27.

† From the Proceedings of the Royal Astronomical Society, May 13, 1853.

If this axis be held horizontally for obliquely, and a rotary motion be given to the bar about it, on letting the axis go, the weight will no longer bring it down, nor alter its inclination at all, but will cause the whole to turn in azimuth, in a direction opposite to that of rotation.

Application of the Microscope to Photography. By the Rev. W. Towler Kingsley.*

The author commenced by a brief account of the laws of refraction, the nature of the prismatic spectrum, and the separation of a ray of light into the heating, light-giving, and chemical rays; he then said—

I shall now proceed to state what is the nature of the change produced by the action of light on silver salts. We may easily conceive that the molecules of the simple substances of which a compound body is formed are capable of different periods of vibration, like two strings of different note; and hence, if the vibrations of the luminiferous ether are taken up by one substance and not by the other, and the chemical affinity of the one for the other is at the same time feeble, chemical decomposition would ensue. This, at any rate, seems to be a reasonable view of the case. The salts of silver are very easily decomposed, and there is always a tendency in them to allow the silver to return to the metallic state. For instance, the oxide of silver is reduced to the metal by heat with great ease, or by placing it in contact with any substance that has a considerable affinity for oxygen. This action, however, is much more rapid if the process be carried on in strong sunshine. The iodide of silver follows the same law; but bromine and chlorine have a greater affinity for silver than iodine; and if we expose iodide of silver to the action of bromine or chlorine, or of both in order, we shall disturb the feeble affinity of the iodine for the silver, and render the compound so unstable that the action of light is quite able to reduce the metal; and if we stop short before we reach this point, it is still possible to carry on the further reduction of the metal by the use of substances which have a slightly greater affinity for the iodine than the silver has in its now altered condition. This process constitutes the whole practice of photography; for though other metals than silver can be used for the purpose, it is the cheapest as yet known that possesses the property of returning to its simple form with sufficient ease for the purpose.

The process of Daguerre, as now practised, is to expose a polished and clean silver plate to the action of the vapor of iodine, and then, for a very short time, to that of bromine, and then a second time to that of iodine. This treatment coats the plate with iodide of silver, and then liberates a portion of the iodine, bromine taking its place. The image of the object to be delineated is now formed upon the plate, and then the plate is exposed in the dark to the action of the fumes of mercury, which in a short time whiten the parts that the light has acted on. It used to be thought that the image was formed by particles of mercury being deposited upon the surface of the silver. This, however, I am sure, is quite a mistake; and though I am unable to explain the whole action that takes

* From the Journal of the Society of Arts, London, No. 85.

place, I have no doubt of the nature of it. The vapor of mercury has a decided affinity for oxygen, iodine, bromine, and chlorine; when, therefore, the plate is exposed to it, the vapor deprives the iodide of silver of its iodine, and deposits pure silver. When bromine and chlorine are also present, silver is reduced, and at the same time salts of mercury are formed; and I have no doubt that the different colors of the lights, according to the different proportions of iodine, bromine, &c., are due to these salts of mercury; but as the quantity is very minute, it is a matter of great difficulty to detect them,—calomel and the black oxide I have detected. After the plate has been acted upon by the mercury, it is fixed by first removing the unreduced iodide by a bath of hypo-sulphite of soda, and then by gilding it slightly with hypo-sulphite of gold. If the action of the light be too strong, metallic silver is formed at once, and then the mercury unites with it, and forms an amalgam that is not as light in color as the silver reduced in the first instance. This seems to be one of the points where there is hope of gaining by further experiments; for if some way of reviving the silver on those parts of the plate where the light has not actually reduced the silver can be discovered, without destroying the revived parts, we should be able to make sure of every plate by merely giving time enough to the exposure to the light. I may mention that the vapor of aldehyde gives promise of effecting this object. As a deoxidizing or deiodizing agent, it is most powerful, but the difficulty is to restrain its action. For the microscope, Daguerreotype plates prepared in the usual manner are quite capable of receiving an impression in about a minute's exposure. These impressions, however beautiful, will never be as useful as those taken on glass or paper, and which admit of being copied photographically.

The most simple process is that known under the name of the Collodion Process, introduced by Mr. Scott Archer.

It is not worth while to describe the method of making collodion, as it can be bought ready made as cheap as it can be made. With it a very small quantity of iodide of silver, dissolved in iodide of potassium or in cyanide of potassium, is mixed. This is now to be poured on a plate of glass, and the excess poured off again, so as to leave a film of the preparation on the glass surface. The plate is now to be plunged into a bath of nitrate of silver, 30 grains to the ounce of water; and as soon as the whole of the plate will retain the water without running into streaks, the plate is to be exposed to the action of the light; then it is to be plunged into a bath of pyrogallic acid, 3 grs.; water, 1 oz.; glacial acetic acid, 1 drachm. This deiodizing and deoxidizing bath develops the image; the unreduced iodide is then to be removed by hypo-sulphite of soda. This is the ordinary process, and the method is simple and good. If we add to the collodion mixture a small quantity of iodide or bromide of iron, and develope with protonitrate of iron, the process is rendered much more energetic; for we obtain on the plate, as soon as it goes into the silver bath, nitrate of iron, which deiodizes the plate as soon as the light strikes it. I do not find these preparations of iron to keep well, and therefore the preparation should be made only a short time before it is to be used. Iodide and bromide of arsenic are also admirable accelerators, and appear to keep for months without change; with them either the pyrogallic solution

or protonitrate of iron may be used. I do not think that the collodion process will be as good as the paper processes, because it is a very difficult matter to coat large glass plates; and after they are finished, they take up a great deal of space; also, they are more troublesome to take positives from.

I may here mention that albumen, treated exactly the same as the collodion, only dried and heated after being poured on the glass, acts just as well and as quickly.

I shall now describe the method of preparing the paper I use. I have no doubt that many others are just as good.

I prefer Canson's paper, and use it either waxed or not, with nearly the same results; but the waxed paper is the more easily managed, on account of its not becoming so tender from soaking. The paper is first to be soaked for some hours in a bath as composed below:

Distilled water, 1 pint;
Iodide of potassium, half-an-ounce;
Bromide of potassium half-a-drachm;
Fluoride of potassium, 1 drachm;
The whites of two eggs.

If this is done under the air-pump, so much the better. The paper is now to be hung up to dry, sheet by sheet; and so prepared, it keeps well, certainly for months. If arsenic be added, as in the collodion, the paper is more sensitive. When it is to be used, it is to be plunged into a bath composed as follows:

Nitrate of silver, 30 grains;
Acetic acid, half-a-drachm;
Distilled water, 1 ounce.

After the paper has become saturated in this bath, it is to be placed on a sheet of pure blotting paper, and that on a sheet of glass, on which it will adhere from the superabundant fluid; it is now to be exposed to the action of the light for the required time, which of course depends upon the intensity of the light; with my microscope, from two to five minutes is quite enough. It is then to be developed in a bath of saturated gallic acid; if the image does not seem dark enough in an hour, a few drops of the silver bath should be added. Hypo-sulphite of soda as usual is the fixing agent. The silver may be used over and over again, if it be filtered with animal charcoal after each time it is used, or as soon as it shows the least sign of becoming discolored.

In these processes we have the affinity for the iodine disturbed by the action of the light; the developing agent carries this further, and the oxygen of the air or water or acid, which has always a slightly greater affinity than iodine for silver, combines with the liberated silver, and produces the dark parts of the impression; if the action is carried still further, we get the silver revived; and in the collodion process this produces a positive. To obtain these collodion positives, the quantity of silver in the collodion should be small, and the exposure only for an instant; after the plate is developed and fixed, it should be put into a bath containing either aldehyde or grape sugar, which will revive the silver with great bril-

liancy. The paper pictures may be developed by placing them in the mercury box, but it is not a good way of doing it. There is one use of the collodion which is of service. In the use of very high powers with very delicate objects, it is not easy to see the image formed on the vesculine screen as described hereafter. When therefore an approximate focal distance has been obtained, a collodion positive on a small scale of a portion of the image can be taken in a few moments, and so the correctness of the arrangements tried before placing the paper in its place.

I shall now proceed to describe the instrument I use. Sunlight is of course far superior to any artificial light, when we can obtain it; but as the sun will not shine whenever we choose, it is of the greatest importance to construct the instrument for artificial light, and then modify it so as to be applicable to sunlight. The light I use is the common oxyhydrogen light; magnesia or quartz may be substituted for lime ball with advantage.

The optical parts of the instrument divide themselves into four groups. The light collecting, the condensing, the objective and magnifying lenses. The first group for collecting the light consists of three lenses; the first a meniscus of about three inches focal length and two and a half diameter, the second plano-convex, and the third a double convex with the radii of the surfaces one and six. The focal lengths of these two lenses being respectively six and eight inches.

The second group, or condensing lenses, is a similar one turned the other way and on reduced scales to suit the different object glasses; between these two systems there is a plano-convex placed at its focal length from the focus of the collectors, so as to allow the rays to pass parallel to the condenser. This lens and the condensers must be changed with the object glasses; for it must be borne in mind that we have to arrange the instrument so as to make the image of the lime ball just cover the paper to be acted upon; and so if we diminish the focal lengths of the condensers at the same time that we increase the magnifying power of the instrument, we shall have just as great an amount of light with the highest as with the lowest powers.

The next group of lenses are those of the object-glass, which requires to be very much under corrected for visible color, leaving strong red fringes. A very simple way of making the object-glasses of an ordinary good microscope do for photographic purposes is to have a new front lens made for them; so that they can be used for either the ordinary or the photographic microscope. At this point of the arrangement we have a very good form of the oxy-hydrogen microscope; but it is a bad one for photography, as we cannot have the screen on which the image is to be formed, so near, as to enable us to use the slow motions of the various arrangements at the time we are looking at the image, except for very low powers.

We now come to the last group, which occupies the place of the eye-piece of the ordinary compound microscope. This group is a form of the Ramsden or positive eye-piece, which ordinarily consists of two plano-convex lenses, placed at two-thirds their focal length, which is the same in both, and with their plane sides out. This eye-piece is not achromatic, being under corrected. The addition of a plano-concave flint lens to a double convex crown, is used by me in the place of the lens next the

object. This enables me, by a slight change of distance, to make the correction perfect.

I have only to describe the best way of using this instrument; and here, it must be remembered, that all depends upon the object-glass being good; it is very easy to get one of small angle that will give very short outlines of objects, but we must not be content with such images as these; we must get object-glasses of large angular aperture, made perfect for this purpose, so as to show well the structure of objects, as well as their outlines. This is quite feasible. Suppose, then, that we have got a perfect instrument.

At the place of the focus of the object-glass place a screen of æsculine, and a dark blue glass between the collectors and condensers; we shall now, "thanks to Professor Stokes," see the chemical image; and the correction for spherical aberration must now be made in the ordinary manner. Now put in the eye-glass or magnifier, and the æsculine at the screen, and adjust the focus. This focus will be found even in the case of chemically corrected lenses, beyond the visible; but in the case of the ordinary best object-glasses, the difference is enormous; for instance, in the case of a very fine one-fifth in my possession, if I form an image at one foot from the eye-glass, I find the chemical image ten feet further back; of course, such a lens is of *no* use for photography.

The æsculine also enables one to see at once when the light on the screen is the most intense for chemical action.

In conclusion, I have to state that one of the specimens sent was taken upon a disk of five feet diameter, which was illuminated equally, and therefore anything may be taken on that scale on paper with artificial light, and I dare say on a very much larger scale still. I look upon it, therefore, that we must give our chief attention to the corrections of the lenses, as all the other parts of the process seem to require little further than mere care in the use of common formula. I have also to add, that the focal length of the condenser being selected, in order to give the image of the incandescent spot of lime on the right scale, its angular aperture should be a shade less than that of the object glass.

Also, if a spot of tin-foil be placed on the condenser, we can get the object bright on a dark ground; and if an opaque object be placed in the focus of the collecting lenses, and the object-glass and eye-piece be turned round to the front of the object, a very good image may be got with low power.

Mr. Foster, as an amateur in photography, wished to express his high sense of importance of Mr. Kingsley's experiments, especially with regard to lenses, in respect to which they were far from having arrived at perfection. The data, however, furnished by Mr. Kingsley's experiments would, he trusted, lead to results more satisfactory than had hitherto been gained.

A Gentleman, referring to some of the experiments Mr. Kingsley had just shown, asked if there were anything peculiar in his mode of bringing out the Daguerrean image?

Mr. Kingsley said he had merely performed the experiment in question for the purpose of showing that the development of the image on a daguerreotype plate did not depend, as some suppose, on the precipitation of mercury on its face. The agent he had used for that purpose was merely a solution of common pyro-gallic acid.

The Chairman said, that as by means of the microscope beauties were discovered which were not seen before, he wished to ask Mr. Bowerbank to what extent these magnified images might be again magnified, and what advantages might be obtained by the process?

Mr Bowerbank said, no good was to be gained by magnifying any object beyond the point of obtaining a good definition. Referring to one of the specimens exhibited, he remarked that it was even too large to be of service for the purpose of physiological science; whereas, had it been taken by a low-power glass, with considerable penetration, instead of by a high-power glass with a large angle of aperture, he thought Mr. Kingsley would agree with him that it would have been better. With the greater number of microscopic objects, increase of size was not so much to be desired as extreme penetration. He was glad to see the progress which Mr. Kingsley and some other gentlemen were making in this department of the photographic art. In the last number of the *Microscopic Journal*, he understood there were one or two figures given, showing not only the possibility but the probability that periodicals would be illustrated in this manner, and thus much greater accuracy obtained than could be arrived at by means of the pencil. He hoped the time was coming, when photographic pictures in journals would be as common as those by the *camera lucida*.

Mr. Varley confirmed the observations of Mr. Bowerbank.

Mr. Samuel Highley, Jun., said that the value of the application of photography to the microscope could not as yet be sufficiently estimated; but undoubtedly it would perform a very important part in the advance of the science of microscopy, for not only were we enabled to multiply and distribute delineations of scarce objects, and thereby elicit the opinions of other observers, but in many instances where there was diversity of opinion and contradictory statements regarding minute structure, it would aid others in forming an opinion as to what had really been seen; as a faithful representation of what existed in the field of the microscope was insured to us, entirely free from the suspicion of having been delineated by a hand biassed by pre-conceived ideas. With the permission of the meeting, he would read a letter which he had that day received from Mr. Fox Talbot, as it conveyed information as to the first employment of sensitive media for securing delineations of magnified objects.

"Lacock Abbey, May 10, 1853.

"Dear Sir:—I have great pleasure in replying to your question. The first person who applied photography to the solar microscope was undoubtedly Mr. Wedgwood, as appears by his paper in the Journal of the Royal Institution for 1802; but none of his delineations have been preserved, and I believe that no particulars are known. Next in order of time to Mr. Wedgwood's, came my own experiments. Having published my first photographic process in January, 1839, I immediately applied it to the solar microscope, and in the course of that year made a great many microscopic photographs, which I gave away to Sir John Herschell, Sir Walter Calverley Trevelyan, and other friends. The size of these pictures was generally that of a half sheet of writing paper, or about eight inches square. The process employed was my original process, termed by me at first "Photogenic drawing," for the calotype process was not yet invented. I succeeded in my attempts, chiefly in consequence of a careful arrangement of the solar microscope, by which I was enabled to obtain a very luminous image, and to maintain it steadily on the paper during five or ten minutes, the time requisite. From the negative, positives were made freely, in the usual way. The magnifying power obtained was determined by direct measurement of the image and the object itself, which gave for result a magnifying power of seventeen times in linear dimensions, and consequently of 289 in surface. The definition of the image was good. After the invention of the calotype process, it became of course a comparatively easy matter to obtain these images; and I then ceased to occupy myself with this branch of photography, in order to direct my whole attention to the improvement of the views taken with the camera. I remain, &c.,

H. F. Talbot.

"Mr. Samuel Highley, Jr."

In a letter to the editor of the *Athenæum*, which appeared in that Journal last summer, Mr. Dallas again drew attention to the application of photography to the microscope, and stated that he had obtained very favorable results; but he did not give the details of the means employed. In the autumn of last year, whilst in Edinburgh, he (Mr. Highley) had an opportunity of seeing some of these views, but they were wanting in definition. In October, 1852, Mr. J. Delves introduced to the notice of the Microscopical Society, some very beautiful Collodion positive and negative pictures, in which the definition was

extremely sharp. This Mr. Delves attained by removing the eye-piece of the microscope, and inserting that end of the body into a dark chamber or camera, twenty-four inches in length; beyond this point the image was not sufficiently defined; the object was placed on the stage, the direct rays of the sun received on the mirror, and reflected in the direction of the axis of the microscope; the object was then focused on the ground glass of the camera, the sensitive collodionised plate replaced the focusing glass, and an image was obtained in from 10 to 60 seconds. As the chemical and visual foci did not coincide in microscopic object glasses, in consequence of their being *over-corrected*, allowance for this was necessary, and was effected by bringing the lens nearer to the plate by aid of the fine adjustment. The amount of correction varied with every object glass, and must be ascertained by direct experiments; but whilst the lower powers required a considerable amount of correction, the higher needed but a slight, if any alteration. Mr. Highley then introduced to the notice of the Society a microscopic camera, founded on the arrangement of Mr. Delves, but presenting the advantages of compactness, and being always arranged for immediate use; whilst to those photographers who were not already possessed of a microscope, it would be found an economical arrangement. It consisted of a tube which screwed into the flanch of a photographic lens, and carried the object-glasses. Over this fitted another tube, and by the sliding movement formed the coarse adjustment. This outer tube carried the stage and its fine adjustment on its upper side. To its under surface was attached a smaller tube, to which the mirror fitted, and which likewise carried the fittings for the polarizing prisms. Behind the object-glass was a fitting for the analyzer. Mr. Highley was of opinion that in many instances where the object was of a nature that depolarized light, advantage might be taken of this property to bring them up to *actinic* tints by the employment of polarized light and Darker's Selenite Stage; for whilst by this means the object would be of a color that would produce the greatest amount of chemical effect, the plates of selenite being *minus* the thickness and refracting power of the object, would produce a background several tints less intense in color and in actinic action. He referred to a diagram representing the various colors exhibited by a plate of selenite of varying thickness when viewed by polarized light, and likewise to the object itself in a polaroscope; also to another diagram representing crystals brought up to a deep blue by aid of selenite plates, the ground being of a greenish tint; and to the objects themselves arranged under polarizing microscopes. By such an application we should likewise probably be enabled to obtain representations of the internal structure and directions of tension in crystalline bodies. In reference to the asserted necessity for complete steadiness, Mr. Highley stated that Mr. Shadbolt had taken a great many views by the camphine light, in London, without any special arrangement for securing greater steadiness than was usually obtained in houses in London.

Mr. Kingsley said that this was done with low powers; whereas the specimens which he had exhibited were taken with higher powers. He wished to show that the very highest powers of the microscope might be used, and that the light could be obtained for the highest magnifying powers they had. He had taken one as high as fifty thousand diameters; the time required being about ten minutes.

Mr. Bowerbank handed to the Chairman a photograph of a *Navicula angulata*, taken by Mr. Delves with a one-twelfth object-glass.

On the Composition of the Substances employed by the Chinese in the Decoration of Porcelain. By MM. Ebelmen and Salvetat.*

(Continued from page 133.)

6. *Reds.*

It has already been stated, that the substance called *fan-hong*, contained both in the collection of the Musée Céramique and in that of the Ecole des Mines, although classed amongst the reds, was not a color, but only an oxide of iron serving as a base to several colors. The authors have found that four colors in M. Itier's collection contained this substance. Three of these were nothing but *fan-hong* mixed with a substance, the object of which is to fix and glaze the oxide of iron; to these M. Itier has

* From the London Chemical Gazette, No. 244.

given the names of *jaune orangé rouille*, *couleur de chair* and *couleur de rouille*. The fourth is a mixture of one of the preceding with the yellow *chang-hoang;* this is called *jaune sale* by M. Itier.

Ta-hong, i. e. strong red (ticketed *jaune orangé rouille*).—This is in elongated, amorphous, rounded, shining fragments, not friable, crushed with difficulty, and burning with a very distinct odor of glue. In the fire it loses 24·4 per cent. of its weight; with dilute nitric acid it gives a prolonged effervescence, and the fluid contains an abundance of lead. Boiling muriatic acid destroys its color completely. All these characters show that this color consists of a mixture of white lead (*yuen-feng*) with oxide of iron (*fan-hong*) and glue.

This color, laid upon porcelain, and exposed to a heat at which other colors become sufficiently glazed, became adherent only in the thin parts; the thicker portions remained pulverulent.

Tse-hong, or fine rose-red (ticketed *couleur de chair*).—This color is in bright red fragments, of a more rosy tint than those constituting the *ta-hong*. It is difficult to powder; and when calcined, exhales the characteristic odor of burnt glue. It effervesces with dilute nitric acid, which afterwards contains lead; its color is destroyed by boiling muriatic acid; it contains only a small per centage of silica. When applied to porcelain, it behaves exactly like the preceding red. The analysis of these two reds gives—

	Ta-hong.	Tse-hong.
Loss by heat,	24·40	23·40
Silica,	0·90	5·60
Oxide of lead,	59·00	62·52
Oxide of copper,	trace	trace
Alumina and peroxide of iron,	14·15	7·20
Lime,	1·00	1·00
Magnesia,	trace	trace
Loss,	0·55	0·28

Silica is wanting in both these colors, the small quantity found in the second arising probably from the addition of a little flux. This coloring oxide is not the only one which can be transformed into a porcelain color by the simple addition of oxide of lead, as we have seen in analyzing the Chinese porcelain-blacks. This mode of employment, from the want of siliceous flux, sufficiently explains why the colors only burn smooth in the thinner portions, remaining dull and powdery when laid on thicker.

These analyses confirm the statements of Father Ly with regard to *fan-hong*, in the descriptive catalogue of the collection of the Ecole des Mines: —"To every ounce 5 oz. of white lead are added, and the whole triturated together; the mixture thus formed is used as a color." In M. Itier's first red the oxides of lead and iron exist in the same proportions.

P'ao-chi-hong, i. e. precious stone-red (ticketed *couleur de rouille*). —This color differs completely from the preceding in the manner in which it behaves in the fire, glazing both in the thick and thin parts. It is with this color that the Chinese produce those shining red grounds, in the midst of which they frequently form, by scraping, white ornaments with the happiest effect.

It is a homogeneous red powder, emitting no odor of burnt glue when calcined. It effervesces only for a very short time with dilute nitric acid; the solution gives a black precipitate with sulphuretted hydrogen.

The color is destroyed by boiling muriatic acid. The solution behaves like a solution of iron in nitro-muriatic acid containing a little chloride of lead. Analysis:—

Loss by heat,	2·20
Silica,	36·10
Oxide of lead,	41·16
Oxide of copper,	trace
Oxide of iron and alumina,	17·00
Magnesia,	trace
Lime,	1·10
Alkalies and loss,	2·44

Kou-tong, *i. e.* old copper or old bronze (ticketed *jaune sale*).—This is a brick-red powder, which when burnt on porcelain gives only a dull yellow tint, without glazing; this is the behavior of a mixture of a yellow with an iron-red. The color therefore does not possess the tint which it exhibits after burning. Boiling muriatic acid destroys all its color; the resulting liquid contains antimony, lead and iron. Analysis:—

Loss by heat,	6·30
Silica,	22·00
Oxide of lead,	56·64
Oxide of copper,	0·20
Oxide of iron,	7·20
Alumina,	0·40
Lime,	1·40
Magnesia,	trace
Antimonic acid,	1·02
Alkalies and loss,	4·34

From this it appears that the Chinese understand the use of oxide of iron to produce both glazed and unglazed red colors, but it is remarkable that they should be ignorant of the different tints which may be obtained with this same substance, by exposing it during its preparation to a gradually elevated temperature.

Other Chinese reds, obtained by the authors from M. Itier's and Father Ly's collection, and from that of the Musée Céramique, are the following:—

Seng-yen-tchy-hong, or red of first quality, requiring no addition; for use it must be pounded (Ly).—This consists of brownish, lustrous fragments, externally vitrified, and presenting internally some pulverulent rose-colored portions. The external fragments give a rose-colored powder with a slight violet tint. This powder is the same as the

Si-yen-tchy-hong, or prepared red of first quality, used without addition of *yuen-fong* (Ly).—It contains some carbonate of lead. These two colors have the strongest affinity with the two following.

Seng-ting-hong, *i. e.* red of second quality, requiring no addition of *yuen-feng*; for use it must be pounded (Ly).

Si-ting-hong, prepared red of second quality, requiring no addition of *yuen-feng* (Ly).—These colors are attacked with difficulty by cold nitric-muriatic and nitro-muriatic acids. Hot concentrated nitric acid takes up a large quantity of oxide of lead and some silica, but part of this remains in a gelatinous state. The rose color is persistent, and seems to become concentrated in the residue insoluble in nitric acid. This residue is rapidly attacked by hot concentrated solutions of potash and soda, or their car-

bonates, leaving only a few blue flakes of finely-divided gold. Boiling nitro-muriatic acid destroys this color; there remains a deposite of silica and chloride of lead; the color disappears, and the liquid contains perchloride of gold. Boiling muriatic acid dissolves it with difficulty, and leaves an unattacked powder; the liquid does not contain any gold. The color contains neither tin nor boracic acid; its essential constituents are silica, oxide of lead, potash, soda and gold; its inessential constituents, alumina, copper, iron, lime and magnesia. The analysis of the two colors in both states gives the following results:—

	Yen-tchy-hong.		Ting-hong.	
	Seng.	Si.	Seng.	Si.
Loss by heat,	1·21	3·60	1·19	3·20
Silica,	40·00	38·80	39·71	38·30
Oxide of lead,	48·55	47·37	48·70	48·00
Alumina,	0·20	trace	0·45	0·29
Peroxide of iron,	0·31	0·30	0·23	0·30
Lime,	trace	trace	0·41	0·15
Magnesia,	0·05	trace	trace	trace
Potash and soda,	8·00	7·54	7·90	7·60
Oxide of copper,	0·40	0·40	0·30	0·44
Metallic gold,	0·20	0·25	0·20	0·30
Loss,	1·08	1·74	0·91	1·42

The quantity of gold was determined in the dry way by fusing 10 grms. of the color with 15 grms. of tartrate of soda, 10 of borax, and 10 of fused carbonate of soda; the mixture was allowed to cool in the crucible, which was then broken, and the gold obtained by cupellation from the button of lead formed; the gold weighed 0·025 grm., which agrees with the quantity ascertained by the humid way.

From these analyses it appears that these four colors are identical. They came from King-te-tching; a sample of the following color, obtained by M. Itier at Canton, having the same composition, we may regard it as the general constitution of gold colors in China.

Hong-hoa, *i. e.* safflower-red (ticketed *laque rose sale*).— It is a rose-colored powder, slightly purple, which behaves with acids like the preceding colors. It is, in fact, the same substance, as may be seen from the analysis:—

Loss by heat,	1·40
Silica,	41·78
Oxide of lead,	44·13
Oxide of copper,	0·26
Alumina and oxide of iron,	2·40
Lime,	1·60
Magnesia,	0·11
Metallic gold,	0·38
Alkalies and loss,	7·94

M. Itier's collection contains two more colors, consisting of mixtures of this red with other colors which have already been noticed.

Tsing-lien, *i. e.* nenuphar-blue (ticketed *amaranthe foncé*).—A light violet powder, which under water is seen to consist of three differently-colored substances,—one colorless, the second rose color, the third blue. The mixture effervesces very slightly with dilute nitric acid.

Hong-fen, or red powder, literally red meal (ticketed *rose couleur cobalt*).—A pale rose-colored powder, consisting of a mixture of white and red powders. The authors have not been able to find the least trace of oxide of cobalt. The analysis of these two colors gave—

	Tsing-lien.	Hong-fen.
Loss by fire,	2·00	1·40
Silica and oxide of tin,	41·80	39·30
Oxide of lead,	45·16	48·25
Oxide of copper,	0·50	0·20
Alumina and oxide of iron,	0·60	1·00
Lime,	1·20	2·02
Magnesia,	trace	0·05
Metallic gold,	0·20	0 35
Oxide of cobalt,	0·20	0·00
Undetermined substances,	8·34	7·43

Thus, whatever be the source of the Chinese porcelain colors, they all present a very striking general character,—a slightly varying glass, composed of silica, oxide of lead, soda and potash, containing as silicates a certain per-centage of coloring oxide. The only exceptions are the oxides of iron and manganese, employed as reds and blacks; and this is the case only because these oxides, if dissolved in silica, no longer furnish red and black colors. No color contains borax or boracic acid. This peculiarity in the composition of the Chinese colors naturally induces peculiarities in the decorations which they are employed to produce, and thus it is that the Chinese and Japenese porcelain paintings acquire their distinctive character.

The multiplicity of colors produced in Europe by mixture is unknown to the Chinese, and they are even quite ignorant of many of our materials. Their coloring matters are limited to oxide of copper, gold, antimony, arsenic, tin, impure oxide of cobalt, oxide of iron and oxide of manganese. In Europe when they make use of these various oxides, they derive great advantage from substances unknown to the Chinese. Thus the tint of pure oxide of cobalt is modified by the addition of oxide of zinc or alumina, or sometimes of alumina and oxide of chromium; pure oxide of iron furnishes about ten reds; by combining different proportions of oxide of iron, oxide of zinc, and oxide of cobalt or nickel, pale and dark ochres are obtained; browns are prepared by increasing the quantity of cobalt in the composition of the ochre, and blacks by the suppression of the oxide of zinc, in the same preparations. Yellows are rendered paler by the addition of oxide of zinc or tin, darker by oxide of iron. Oxide of chromium, either pure or combined with oxide of cobalt, or with the oxides of cobalt and zinc, gives a series of greens, varying from yellowish green almost to pure blue. Metallic gold furnishes the purple of Cassius, which may be transformed at will into violet, purple, or carmine. Oxide of uranium and the chromates of iron, cadmium and baryta, furnish useful colors; and lastly, we employ the metals which are inoxidable in the fire, and the preparation of which requires a degree of chemical knowledge which the Chinese are far from possessing.

All these oxides are simply mixed in the European colors, whilst in the Chinese they are dissolved. In fact, the following analyses of materials known in France as enamels exhibit exactly the same composition as the

Chinese porcelain colors. These are enamels used for articles of bijouterie in copper, gold, and silver:—

	Blue for copper.	Gold for copper.	Green for silver.
Loss by heat,	1·00	0·06	0·10
Silica,	51·00	47·70	53·68
Oxide of lead,	34·57	31·19	25·30
Oxide of cobalt,	1·00	0·10	0·00
Oxide of iron,	trace	0·40	0·46
Oxide of manganese,	0·00	1·20	0·30
Alumina,	trace	0·26	0·60
Lime,	2·00	1·80	1·26
Magnesia,	trace	trace	trace
Oxide of copper,	trace	trace	0·60
Metallic gold,	—	0·46	0·00
Potash and soda,	10·43	13·23	17·80
Oxide of tin,	—	3·60	0·00

The fluxes which are used in enamelling on gold, silver and copper, and that which is applied over the painting called *sous-fondant* in France, may also be compared with the colors used by Chinese in the decoration of their porcelains; it will be seen that these compounds are similar. The only difference is in the degree of fusibility, which is greater in the Chinese enamels:—

	Flux for silver.	Flux for gold.	Flux for painting (*sous-fondant.*)
Loss by heat,	0·30	0·10	0·10
Silica,	48·10	53·60	44·82
Oxide of lead,	38·25	31·19	41·59
Oxide of copper,	0·32	trace	trace
Oxide of iron,	0·25	0·40	0·31
Oxide of manganese,	0·00	0·60	0·15
Alumina,	0·24	0·54	0·46
Lime,	0·60	1·26	0·82
Magnesia,	trace	trace	0·05
Alkalies,	12·04	12·31	11·70

The similarity exhibited by comparison of the composition of these enamels with the Chinese porcelain colors, is also shown in the behavior of both in the fire on porcelain. It has long been known that enamels will not burn on European porcelains, from their scaling off. The Chinese colors sent by Father Ly and M. Itier, when tried upon European porcelain at Sèvres, acted in exactly the same manner, whilst when applied to Chinese porcelain they burnt well in. The authors consider that the cause of this lies in the difference between the glaze of the two porcelains. It is stated in the former part of this paper, that the Chinese porclain mass, being more fusable than the European, must therefore be covered with a more fusible glaze; and it is the introduction of lime into the glaze, which, diminishing its infusibility and modifying perhaps its dilatability, approximates its physical properties to those of enamels.

If the aspect of the Chinese porcelains be different from that of the European, if the harmony of their decorations appears more varied, it is, according to the authors, the necessary result of their methods. All their colors contain but little coloring matter; they only possess strength of tone when laid on to a thickness which gives their paintings a relief which it

is imposible to obtain by other means; the harmony of their paintings is the consequence of the nature and composition of their enamels.

In addition to samples of the colors used in China, Father Ly has also sent specimens of the gold employed there in the decoration of porcelain, of the substance used as a diluent, and of the pencils employed in laying on the colors.

Metal.

Gold is the only metal used by the Chinese. Father Ly has sent two specimens, the one green the other yellow gold.

Khong-tchhy-king is prepared gold color of the first quality.

Koang-king, prepared gold color of second quality.

The samples resemble that known in Europe as *honey-gold* or *shell-gold*. According to Father d'Entrecolles, the gold is powdered and laid on the wet surface of a porcelain vessel until a thin layer of gold is formed. It is then dried; for use, it is diffused in a sufficient quantity of gum-water, and 3 parts of white lead mixed with every 30 parts of gold. It is curious that the proportion of gold and flux employed is the same as at Sèvres; the flux employed at that place, instead of white lead, is the basic nitrate of bismuth.

Diluents.

The Chinese use water to dilute these colors, instead of oil of turpentine, which is employed for this purpose in Europe. Only a few colors require the addition of a particular substance to render their employment easy. This substance is called *yeou-p'hy-kao*; it is a size made of bullock's skin. The colors to which it is added are, according to Father Ly, *fan-hong*, *feng-hong* and *ching-lan*; but the authors have also found it in the black called *si-feng-liao* by M. Itier. It is this substance which produces the odor of burnt glue evolved by these colors on calcination.

Pencils.

M. Itier brought from Canton an assortment of the pencils with which the Chinese of that place applied their colors to porcelain. The collection of the Ecole des Mines contains an assortment sent from King-te-ching by Father Ly. All these pencils are of a similar structure; they consist of a long hollow stalk, like a reed, in the interior and at the extremity of which some very long hairs are firmly fixed. According to Father Ly, "there are common and fine brushes: some serve for laying on various colors, others for painting delicate flowers, some for painting with common red, others with fine red."

Summary.

This examination of the materials employed by the Chinese in the decoration of porcelain leads to the following results:—

1. The *muffle colors*, that is to say, colors which bake at a very low temperature compared with that necessary for the baking of the porcelain, are far less numerous.

2. The palette is not composed of colors properly so called, but of

enamels; that is to say, of plumbo-alkaline glasses, variously colored by means of a small per-centage of *dissolved* coloring oxides.

3. The composition of the glass is in general but little varied, and the coloration always slight: it is this lightness of tone, together with the liveliness of the tint, which gives the Chinese porcelains their characteristic harmony and richness.

4. The enamels are colored by oxide of cobalt, oxide of copper, gold, antimony, tin, and arsenic.

5. The enamels are applied with water, sometimes with the addition of some size formed of bullock's skin.

There are also certain hard coloring matters employed by the Chinese in various ways, of which the authors have said nothing in their present memoir; they propose to make them the subject of a third and last memoir on this subject.—*Ann. de Chim. et de Phys.*, July 1852, pp. 332-365.

On the best Mode of Focusing the Photographic Apparatus. By A. Claudet.*

Sir,—Not having the honor to belong to the Photographic Society, I have only just heard that one of its members proposed at one of the meetings some time ago, a new mode of focusing the instrument in order to obtain a broader effect in portraiture, or when artists make use of Photography for sketches, and studies for compositions of figures, &c.

Upon inquiry, I have found that the mode consists in endeavoring to place the object a little out of focus, instead of endeavoring to focus as correctly as possible.

The author of this suggestion being one of our most eminent miniature painters, and at the same time an experienced amateur in photography, his opinion deserves to be examined, and his views perfectly understood. I must own, that as a photographer, I was not a little startled at the announcement of this idea; but coming from such an artist as Sir William Newton, I would not pass a judgment without mature reflection; and I now wish to discuss the question, in order to discover if the means recommended by Sir William will fulfil the object he is aiming at, and if there are not some better means to arrive at the same result.

About eight years ago, when I began to adopt the practice of taking non-inverted portraits, I observed that I always obtained a more artistic effect when the image had been reflected by a prism, before being refracted in the camera obscura, than when I operated without a prism, and produced inverted portraits. Comparing the two different results with Mr. Talbot, the gentleman observed, that the pictures taken with the addition of the prism were softer and more harmonious than those taken without the prism; and in trying to explain the cause of the effect, we came to the conclusion, that the slight imperfection inseparable from the use of the best glass prism of a considerable thickness, which did not refract the rays in a mathematical regularity, but with a certain degree of

* From the Journal of the Society of Arts, London, No. 90.

confusion, owing to the want of the matter in all the parts of the prism being perfectly homogeneous, and that the softness of the effect was produced by the rays slightly overlapping each other where they ought to be separated.

I was struck with this fact, and I began a series of experiments on the subject. I placed before the plate in the camera a very finely-ground glass, and I found that the sharp image of a well-focused, first-rate object glass, was by that means considerably softened, and the effect was artistic. Some time after, mentioning this experiment to Sir David Brewster that eminent philosopher told me that he himself had found a great advantage in the production of positive Talbotype pictures, by placing between the negative and the positive a very thin sheet of tissue-paper.

If I rightly understand the idea of Sir William Newton, these results are exactly those which he wishes to obtain in endeavoring to operate a little out of focus; and I can well understand why a real artist is desirous of avoiding that too minute correctness of details in photographic portrait,—a composition produced by a perfect lens at its exact focus. But there is a means to produce a better effect than by putting the image out of focus, namely, by the interposition of a slightly opaque medium; and the following are the reasons for the preference.

If it were possible to have all the various planes of the subject or composition at the exact focus, a small error in that focus would be the same for all the various planes of the picture, and that error obtained on purpose might soften the harshness of detail, and produce on the whole a more artistic effect. But it is not so; there is only one plane for which we can get an exact focus; all the others are out of focus, and the more so they are father before or behind that plane. So that if the eyes are in the exact focus, the ears and the nose are out of focus, but not in a very conspicuous degree. If the body is turned on one side, and the shoulder and arm which are nearer the apparatus are in the exact focus, the other shoulder and arm are devoid of the same sharpness of outline; and when the shoulder and arm, the more distant from the apparatus, are in good focus, the front part of the body is not so sharp. In fact, the rays converging on one point, by crossing each other, form two opposite angles, the apices of both being on the point of convergence, and from that point the rays converging more and more, the confusion increases the more the objects are put out of focus.

It is, therefore, very clear that if we focus on the most important part of the subject, such as the face, and then push the tube of the lens in or out in the slightest degree, we have the means of softening the harshness of details of a too well defined face; but if we push the tube out, the parts before the face will be more confused than they were before; and if, on the other hand, we push it in, the parts behind will be more confused than they were before. The difference will be incongruous in both cases either for the nearer or for the more distant parts. The confusion in these parts will be such that the drawing will be false, and the outline deficient.

Therefore, as it is not possible to put all the parts of the picture out of focus in the same degree, and as by the interposition of a slightly opaque medium we may have the same degree of softening effect upon the whole

picture, it is preferable, in order to produce the artistic result aimed at by Sir William Newton, to focus the apparatus as correctly as possible for the middle plane of the picture, and to operate through such a medium as I have mentioned.

This subject is as important as Sir William asserts, and if examined carefully, some good may result from the inquiries. The idea is quite rational in its object; but I think that in considering the defects of altering the focus, he will find that it is inconsistent with the scientific considerations of the laws of optics, and for that reason impracticable.

On an Arrangement for taking Stereoscopic Pictures with a single Camera. By Mr. Latimer Clark.*

In introducing this arrangement to the notice of the Society, I do not wish to represent it as calculated to supersede the ordinary method of taking stereoscopic pictures, viz: with two cameras, or even as being so good as that method; but it possesses a few important advantages; the pictures are produced on one plate and by one operation, with no more trouble than an ordinary portrait, and being both formed by the same lens and developed by the same solutions, they are almost sure to possess uniformity of size, tone, and intensity. Many amateurs, too, already possessing one good lens and camera, will be glad to obtain stereoscopic portraits without incurring the expense and encumbrance of two others; lastly, they require no after-adjustment of position for the stereoscope.

The camera exhibited is adapted only to produce pictures of the size of those ordinarily purchased in the shops; the arrangement consists of two parts, viz. the camera frame, which contains the collodion or daguerreotype plate on which the images are successively impressed, and the contrivance for rapidly moving the camera laterally through the requisite arc without deranging the position of the image upon the ground-glass, or iodized plate.

The camera frame or plate-holder contains a narrow dark chamber of the usual construction, capable of receiving a glass plate about 6¾ inches by 3¼; we will call this portion the *slide;* it slides to and fro freely within the frame through a space of 2½ inches or 2⅝, which is about the distance between the eyes; to admit of this the frame must necessarily be 10 or 11 inches long, and it therefore requires some simple adaptation to fit it to the end of an ordinary-sized camera. In the front of the frame is an aperture about 2½ inches square, closed by a sliding door, and capable of being contracted by an oval or other shaped diaphragm, which determines the size and the form of the two pictures impressed on the plate, and which may be varied at pleasure. The distance between the two pictures is determined by the lateral motion of the slide, viz. 2⅝ inches, as stated before. After one of the two images has been impressed, the slide has to be shifted laterally at the same instant, and in the same direction as the camera itself, by means which I will presentlydescribe. The second image is then taken, and the frame removed.

In the foregoing contrivance it is necessary to obtain the focus by a

*From the London Journal of the Photographic Society, No. 5.

separate glass; but in the daguerreotype arrangement the focusing-glass forms part of the apparatus; the slide is here in three pieces; the centre piece is the focusing-glass, which, being hinged at the bottom, does not slide, but falls back out of the way. The two side pieces (each of which is a perfect dark chamber containing a sensitive plate) are now in a position to be drawn successively into the field of view opposite the front aperture, and the images impressed. This makes a very compact arrangement, and requires no door in front of the frame, the plates being exposed to light only when brought opposite to the central opening.

We now come to the means employed to guide the camera in its lateral movement, the object being all the while retained in focus. A strongly framed camera-stand carries a flat table about 20 inches wide by 16, furnished with the usual adjustments.

Upon this are laid two flat bars of wood, in the direction of the object and parallel, and about the width of the camera asunder; they are 18 inches in length; their front ends carry stout pins, which descend into the table and form centres upon which they turn; their opposite ends also carry similar pins, but these are directed upwards, and fit into two corresponding holes in the tail-board of the camera. Now when the camera is placed upon these pins and moved to and fro laterally, the whole system exactly resembles the common parallel ruler; the two bars form the guides, and the camera, although capable of free lateral motion, always maintains a parallel position. In this condition of things it is only suited to take stereoscopic pictures of an object at an infinite distance; but to make it move in an arc, converging on an object at any nearer distance, it is only necessary to make the two guide-bars approximate at their nearer end so as to converge slightly towards the object, and by a few trials some degree of convergence will be readily found at which the image will remain as it were fixed on the focusing-glass, while the camera is moved to and fro; to admit of this adjustment, one of the pins descends through a slot in the table and carries a clamping-screw, by means of which it is readily fixed in any required position. In order, however, to render the motion of the camera smoother, it is advisable not to place it directly upon the two guides, but to interpose two thin strips of wood lying across them at right angles beneath the front and back of the camera respectively (and which may be fixed to the camera, if preferred), and to dust the surfaces with powdered soap-stone or French chalk.

Lastly, it is necessary that the slide should be shifted laterally at the same instant as the camera. The means used for this are simple, and consist only of a pulley fixed to the right-hand side of the camera, round which passes a string which is temporarily attached to the slide, the other end being fixed to the left-hand side of the table. When the camera is drawn to the left hand, this string is long enough to allow the slide to be drawn to the left hand also; but when the camera is moved to the right, the reaction of the string draws the slide also over in the same direction, the variations in adjustment being compensated by the intervention of an elastic band.

The operation of taking a portrait is therefore thus performed. The focus having been adjusted for both positions, and the camera and the slide both drawn to the left hand, the door is raised and the plate ex-

posed—say, for five seconds—by one motion of the hand; the camera is then shifted to the right hand, the slide moving at the same time spontaneously: this occupies less than a second of time; and the plate in its new position having been exposed five seconds longer, the door is closed, and the operation completed—the whole sitting having been supposed to occupy eleven seconds.

The portraits thus taken may be either viewed as positives upon the glass, in which manner they form very pleasing portraits, or they may be transferred to paper; or, lastly, they may be transferred to another collodion plate, by direct superposition and exposure to daylight or gas-light; by this means a positive picture is obtained, which may be either viewed as a transparency, or backed with *white* varnish. The effect of this is good, and deserves greater attention than it has hitherto received.

With regard to the distance between the two positions of the camera, I know of no good reason why the natural distance of the eyes, viz. 2½ inches, should be much exceeded. By moving the camera about four or five inches, a little extra relief is obtained without visible distortion; but if this distance be greatly exceeded, especially for near objects, they become apparently diminished in size, and have the appearance of models and dolls rather than of natural objects. I am aware, however, that there exists much difference of opinion on this subject.

Note on a new Portable Reflecting Stereoscope. By C. Wheatstone, Esq., F. R. S.*

The most perfect and generally useful form of the stereoscope is that with reflecting mirrors described in my earliest memoir "On Binocular Vision," published in the *Philosophical Transactions* for 1838. Pictures of any size may be placed in it, at the proper point of sight, with the proper convergence of the optic axes, and it admits of every requisite adjustment to make the pair of binocular pictures coincide correctly.

I have described in my second memoir a portable stereoscope which folds into a small compass, and which is well suited for pictures not exceeding six inches by four. I have since constructed an instrument, very convenient for carrying about, which is adapted to exhibit pictures of the largest dimensions usually taken, as well as smaller ones, and which may be made use of either for mounted or unmounted pictures. When closed it occupies a space of 9 inches in length, 5 in breadth, and 4½ in height; when expanded the instrument is 2 feet in length, 1 foot in height, and 9 inches in depth. The base and sides consist of jointed bars on the principle of the lazy-tongs; the two mirrors fold together back to back, and, by means of a hinge on their support, fall into a groove on the base fitted to receive them. On the top of each of the expanding sides a clip 9 inches in length receives the picture (which there is no need to mount on card-board), and holds it by the pressure of a suitably disposed spring; and a similar but detached spring clip is applied to the lower end of the picture in order to keep it flat and in a vertical position.

* From the London Journal of the Photographic Society, No. 5.

The pictures being fixed in the clips, so that their reflected images shall appear single and coincide in all their parts, the accurate adjustment to the sight of different persons is effected by sliding to and fro the pillar which supports the mirrors; the optic axes being caused to converge more as the mirrors are moved towards the eyes, and *vice versa*. As the height of the sides is variable through every degree, the pictures are easily adjusted to the same level by pressing on the side which is highest. The length of the base being also variable, the pictures, if it be required, may be placed at different equal distances from the mirrors. If the pictures are not straight with respect to the sheets of paper on which they are placed, one end may be brought lower than the other merely by drawing down that end so that it shall not enter the clip so far as the other.

The instrument is furnished with a pair of ordinary spectacle lenses, No. 24. If the pictures were so placed that their reflected images coincided when the optic axes made an angle of 15°, corresponding to the distance of 12 inches, no lenses would be requisite, as the distance of the binocular image, the convergence of the optic axes, and the adaptation of the eyes to distinct vision would have their customary correspondence. But, for reasons I have elsewhere stated, a much better effect is produced, and the objects appear larger and more distant, when the pictures are so placed that, to cause their most distant corresponding points to concide, the optic axes are parallel, or nearly so; in this case, however, in order to see the objects distinctly, the rays proceeding from them must be rendered less convergent, and for this purpose lenses are necessary.

The lenses are movable in a vertical direction, in order that they may be fixed at the proper point of sight; the effect of a stereoscopic picture greatly depends on its being thus viewed, though it is a circumstance which is very generally disregarded.

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*Experiments in Screw Propulsion.**

In continuation of our notes on this subject, we have to record the following experiments:

The *Cadiz*, a new iron steamer of 950 tons and 220 nominal horse power, built by Messrs. Tod and Macgregor, and belonging to the Peninsular and Oriental Company, was fitted with a Griffith's screw, and tried at the measured mile, at Stoke's Bay, on the 16th June. Of ten runs made with the screw at various pitches, the most successful showed a superiority of a quarter of a knot over the common screw, whilst the vibration was very much lessened.

What, however, has most elated the friends of screw propulsion has been the repeated success of the *Bengal*, whose first voyage, considered beyond praise, has been even outstripped by her second. It appears, indeed, as a correspondent of the *Times* remarks, that "the days of paddle-box steamers are numbered," and the most inveterate supporters of the paddle are beginning to change their minds. The Peninsular and Oriental Company are gradually adopting the screw in their large fleet,

* From the London Practical Mechanic's Journal, July, 1853.

to the entire exclusion of the paddle. This step was first contemplated when the *Bombay*, *Madras*, *Formosa*, and one or two others, proved successful. The *Bengal* was constructed as a final experiment, and we need not wonder that the triumph she has achieved has brought the company to a decision. What steamers they still have on the principle now beginning to be called "old-fashioned," are, for the most part, to be allowed to wear out; but even such of these as are of a suitable shape, and are worth altering and repairing, are to be changed into screw steamers. The *Haddington*, of 1600 tons, is, it is said, to be so metamorphosed, being in need of repairs. The *Himalaya*, of 3500 tons, lately launched, intended to be a paddle-boat when commenced, was subsequently altered to a screw. Amongst those in progress, all screws, are the *Simla*, of 2600 tons; the *Candia*, 2200 tons; the *Pera*, 2200 tons; the *Nubia*, 2200 tons; and the *Colombo*, 1900 tons.

A comparison of the cost and expenses of the *Bengal*, with those of paddle-steamers of similar class, will give reasons for preference of the former, much more appreciable by the commercial mind than mere scientific considerations. The *Bengal* is of the same size as the *Orinoco*, *Parana*, and *Magdalena*, 2250 tons, belonging to the Royal Mail Steam Packet Company, and carrying the West India mails. These vessels have engines of 750 horses power, whilst the *Bengal*, with 470, or about two-thirds of this, has reached a greater speed than any of them. The *Bengal* has a very great advantage with regard to fuel, requiring but 45 tons per day, whilst the three West India boats consume from 85 to 90 tons. A reduction in the amount of fuel, besides diminishing that item of cost, brings with it a gain in the freight; for the *Bengal* could carry 600 to 700 tons of cargo, instead of the mere 250 or 300 tons which the West India steamers are capable of taking, in addition to their 1200 tons of coals. The *Bengal* cost, it is said, about 70,000*l.*, whilst the *Orinoco* cost from 95,000*l.* to 100,000*l.*; and, in addition to all this, is to be considered the difference, in wear and tear, in favor of the screw vessel. With facts like these before them, we cannot be surprised that the attention of men of capital and enterprise is at the present moment so strongly attracted to the new system of propulsion.

On the 18th June, Sir Thomas Mitchell's Boomerang propeller was again tried in the *Conflict*. The instrument employed on a previous trial had been made too weak, and broke almost at starting. On the last occasion no such casualty happened, and a speed of 9⅛ knots was the average result, of eight runs at the measured mile, in Stoke's Bay. The numbers of revolutions averaged 63¾. This speed is said to be somewhat above that obtained in the *Conflict* with a common screw. The diminution of the vibration of the vessel was remarkable. The experiment was, in fact, decided in favor of the new propeller. The trials in Commodore Martin's squadron show that the *Conflict* is far from being a fast vessel, either under steam or canvas; and it is considered that, with vessels of finer lines, proportionately better results will be obtained with the Boomerang. It has continued to be successful in the *Genova*, whose experimental trip we have already recorded; this vessel, on her voyage home from Quebec to Liverpool, having averaged a knot an hour more than she had ever previously done with a common screw.

The attention of the public has also lately been called to another and newer system of screw-propulsion, the invention of Mr. Burch, whose beautiful models have been much admired. The invention is an improvement on Griffith's arrangement. The centre of the propeller is occupied by a large drum. The lines of the ship are made to run into the periphery of this drum, and continue beyond it, finally merging into the stern-post, so that the ship is in the shape of a cone at that part. The blades, of course, project outside the drum, and the water is acted on in an unbroken state, as it flows in straight lines along the ship's side, without winding in under the run, or impinging upon a central globe, as in Griffith's plan. The arrangement is, in fact, the carrying out of a suggestion, in reference to Griffith's screw, made in our own columns a few months back. Mr. Burch has hit upon a very ingenious plan of reducing the friction between the surfaces of the central drum and the casing in which it works. A small pipe, communicating with the atmosphere at its upper end, opens, at its lower end, near the centre of the surfaces to be lubricated; and it is expected that the centrifugal action will draw down the air, so as to interpose a film between the surfaces. The quantity must, however, be so regulated, that none shall pass out into the water on which the blades are acting; otherwise, some of their effect will be lost. The size of the central drum allows of the introduction of mechanism for swivelling the blades, and even of drawing them entirely within the drum. The principle possesses several good points, but the proportion of the cones in the models appeared much exaggerated. We understand the models are on their way to the New York Exhibition.

Since these notes were written, a further set of experiments have been made with Griffith's screw. The object was to test the new screw under both steam and canvas, the wind on the previous occasion not having been sufficiently strong to use the sails. The first trial was made with the angle of the blades set at a coarse pitch, when the engines made 22½ revolutions with the fore and aft sails set. In this manner the *Cadiz* went from Southampton docks to Stoke's Bay, a distance of 14 miles, within the hour, and subsequently ran the measured mile, with a light breeze, as follows:

	Revolutions.	Steam.	Vacuum.	Time.	Speed.
1st Run,	22½	10¾ lbs.	26¾	4′ 54″	12·245
2d Run,	22½	10 "	26¼	5′ 30″	10·909

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*The Application of Chromo-Lithography.**

The present work, Mr. Wyatt tells us in a "Postscript," is "the most important application of Chromo-Lithography to assist the connexion which should subsist between Art and Industry which has yet appeared;" and, further, "that it has been produced upon a scale of magnitude, and with a degree of rapidity, unexampled in this or any other country." The Messrs. Day, it appears, were desirous of demonstrating on a great scale the capabilities of color printing as an auxiliary to industrial education. No expense was spared. Mr. Wyatt was chosen director, twenty distinguished draftsmen were at once set to work, and the whole of the

* From the London Athenæum, June, 1853.

drawings were made without having recourse to the assistance of any foreign artist. Then came the transfer to the stone:—and here Mr. Wyatt shall tell his own story:

"For the purposes of Lithography the original drawing requires, in the first instance, to be carefully traced. It is then retraced, or transferred to the stone, by interposing between the surface of the latter and the drawing a thin sheet of paper, prepared on the side next the stone with red chalk. The lithographer then draws upon the stone with a greasy chalk or ink, as the case may be, the whole of the outline of the subject, and as much of the shading as he may think necessary. On the conclusion of this drawing in black and white, the stone is sent to the printer, who, after chemically preparing it for the operation, takes off carefully as many impressions as there are colors required to perfect polychromy of the original drawing. These impressions on thin paper are laid, whilst yet moist, upon a corresponding number of supplementary or color stones, and passed through the lithograph press. By this means the outline of the first or key-stone is printed off upon each of the remaining stones of the series, and the artist is provided with an outline upon the latter, identical with that which existed upon the key-stone. Carefully analyzing the amount of each color in the original drawing, and noting the points of its predominance, where, in some cases, it is allowed to appear pure, and in others to enter only into the composition of broken tints, the artist proceeds to indicate upon each stone, in black chalk or ink, the requisite amount for each separate color. Great care is required to bear in mind the succession of these tints, and to make due allowance for it, since it is obvious that the last printed, by its greater or less degree of opacity, may tend to kill all that has been done before. Great attention is likewise required in order that, when the various stones are worked together, the filling in of one color shall exactly meet the space occupied by another, without either overlapping and producing dark edges, or leaving white lines or gaps between each tint."

The stones employed in working these one hundred and sixty plates are one thousand and sixty-nine in number, weighing in all about twenty-five tons. These twenty-five tons are now sent to the printer.

"Supposing the artist's work to have been satisfactorily terminated, much now depends upon the printer. Considerable hazard is incurred in the chemical preparation of the stone, since, if washed with acid of too great a strength, all the delicate lines will disappear; or, if etched with too weak a solution, there will be a general tendency in the tints to clog up and become overcharged. Still greater difficulties present themselves in so attaching the paper upon which the impression is taken to each of the stones, as to cause the successive colors to fall into exactly their proper places, or, in technical language, to cause the stone to 'register' well. Considerable practice is necessary before the requisite amount of dexterity can be attained in this respect; and few but those who have stood beside the press, and watched its practical manipulation, would give the workman credit for the degree of skill which is essential to a successful carrying out of this part of the operation. Where great rapidity is indispensable, these difficulties are materially increased; because, if any color

be too heavily printed, it will take so long to dry that it will for some time be impossible to work off the remaining tints upon the same impression."

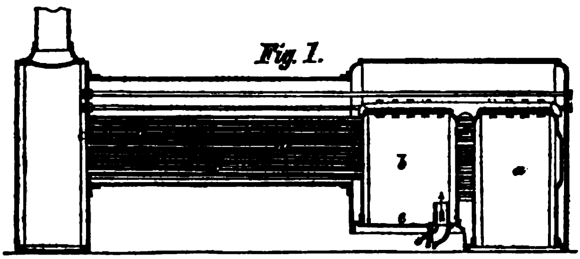
For the Journal of the Franklin Institute.

Milholland's Boiler.

The April number of the *Journal* contains an account and engraving of Milholland's boiler for burning anthracite coal on the Reading Railroad. Is not this boiler identical with one patented in England, in 1845, by John Dewrance, published in Vol. xxix. of the London *Journal of Arts and Sciences*, the description of which reads as follows:

"The first part of this invention, viz: improvements in steam boilers, consists in the application to locomotive engine and other boilers of a box, chamber, or chambers, in addition to the ordinary fire box, whereby the combustible gaseous products of the furnace, in passing to the boiler flues, are caused to mix with atmospheric air, and become consumed.

Fig. 1.



a, is the fire box of a locomotive engine boiler; *b*, an air chamber, surrounded by the water in the boiler, in the same manner as it surrounds the fire box; *c*, *c*, *c*, are short flue tubes, connecting the fire box with the chamber *b*; or, in place of these tubes, the fire box and chamber may be connected by one or any number of flues. *d*, *d*, *d*, are the ordinary flue tubes; *e*, is the bottom plate of the air chamber *b*, fitting air-tight into its place; and *f* is a valve, by which atmospheric air is admitted, through a pipe or pipes, into the chamber *b*, for the purpose of mixing with the gases and smoke evolved from the combustion of the fuel in the furnace. These valves are to be regulated by the engineer, as occasion may require, so as to admit the quantity of air into the chamber which shall be found requisite for completing the combustion of the gaseous products of the fuel. The air being thus admitted into the chamber *b*, becomes mixed with the combustible gases arising from the fire in the furnace, and materially assists in their combustion. By this means a larger quantity of heat is evolved, and communicated to the boiler for the generating of steam, and thus an economy of fuel is effected.

"The patentee claims the use and application of an additional chamber or chambers, (such as the aforesaid chamber *b*,) in locomotive and other boilers, for the purpose of more perfectly consuming the combustible matters evolved from the furnace; but he does not confine himself to the

peculiar form of chamber shewn in the drawing, nor to the precise arrangement or form of the several parts which have been described; this part of the invention being the addition of an air chamber to locomotive and other boilers, for the purposes above described."

BRITANNICUS.

Observations, Economical and Sanitary, on the employment of Chemical Light for Artificial Illumination. By Dr. E. FRANKLAND.*

Until the commencement of the present century, artificial light was derived almost exclusively from the animal kingdom; but the great economy attending its immediate production from our vast stores of vegetable fuel is becoming more and more apparent, and is in fact so generally admitted as to render more than a mere allusion to it and a glance at the following Table, unnecessary.—

Table, showing the comparative cost of light from various sources, each equal to 20 sperm candles burning 120 grains per hour each, for 10 hours.

	s.	d.
Wax, . .	7	2½
Spermaceti, . .	6	8
Tallow, . .	2	8
Sperm Oil (Carcel's Lamp), .	1	10
London Gases, B, C, D, E,† .	0	4¼
Manchester Gas, . .	0	3
London Gas, E, . .	0	2¼

Notwithstanding the great economy and convenience attending the use of gas, and in a sanitary point of view, the high position which, as an illuminating agent, coal gas of proper composition occupies, its use in dwelling houses is still extensively objected to. The objections are partly well founded and partly groundless. As is evident from the foregoing table, even the worst London gases produce, for a given amount of light, less carbonic acid and heat than either lamps or candles. But then, where gas is used, the consumer is never satisfied with a light equal in brilliancy only to that of lamps or candles, and consequently, when three or four times the amount of light is produced from a gas of bad composition, the heat and atmospheric deterioration greatly exceed the corresponding effects produced by the other means of illumination. By using a gas, however, of nearly the normal composition, such as the hydrocarbon gases above named, it is evident that three or four times the light may be employed, with the production of no greater heat or atmospheric deterioration than that caused by wax candles or the best constructed oil lamps. But there is nevertheless a real objection to the employment of gas-light in apartments, founded upon the production of sulphurous acid during its combustion: this sulphurous acid is derived from bisulphuret of carbon,

* From the London Athenæum, June, 1853.

†London Gases, A, B, C, D, E.—These are the gases furnished to consumers by five of the principal London Companies. For obvious reasons the names of the Companies are not mentioned.

and the organic sulphur compounds, which have already been referred to as incapable of removal from the gas by the present methods of purification. The formation of sulphurous acid can readily be proved, and even its amount estimated, by passing the products of combustion of a jet of gas through a small Liebig's condenser; the condensed product being heated to boiling with the addition of a few drops of nitric acid, and then treated with solution of chloride of barium, yields a white precipitate of sulphate of barytes, if any sulphur compound be present in the gas. These impurities, which are encountered in almost all coal gas now used, are the principal if not the only source of the unpleasant symptoms experienced by many sensitive persons in rooms lighted with gas. It is also owing to the sulphurous acid generated during the combustion of these impurities that the use of gas is found to injure the bindings of books, and impair or destroy the delicate colors of tapestry. Therefore the production of gas free from these noxious sulphur compounds is at the present moment a problem of the highest importance to the gas manufacturer, and one which demands his earnest attention. As it is nearly impossible for the consumer to procure gas free from these objectionable compounds, the only method of obviating their unpleasant and noxious effects is to remove entirely the products of combustion from the apartments in which the gas is consumed, and thus prevent them from mingling with the circumambient air. This suggestion was first made by Faraday, who, accomplishing this object, contrived the very beautiful and effective ventilating burner (in operation upon the lecture table). This apparatus, which is used at Buckingham Palace, Windsor Castle, the House of Peers, and in many public buildings, may be truly said to have brought gas illumination to perfection; for not only are all the products of combustion conveyed at once into the open air, but nearly the whole of the heat is in like manner prevented from communicating itself to the atmosphere of the room. The only obstacles to the universal adoption of this description of burner are, its expense, and the difficulty of conveying the ventilating tube safely into the nearest flue without injuring the architectural appearance of the room. The public at large will, therefore, await the removal of the objectionable compounds in question by the gas manufacturer, before they will universally adopt this otherwise delightful means of artificial illumination.—*Proc. Roy. Inst.*, *May* 20, 1853.

The allegation that the present method of gas purification will not remove all the sulphur, is certainly erroneous. We have seldom been able to find a trace of sulphur, either in the gas of our City, or in its products of combustion. The test alluded to, unless carried much farther, would not distinguish the sulphuric from carbonic acid. ED.

*A Suggestion in Gas Lighting.**

Every one who has had experience of rooms lighted with gas must be aware of the great heat produced by its combustion, and of the effect it has in diminishing the purity of the air, and therefore rendering it less

*From the London Builder, June, 1853.

fit for respiration. Now, I beg to propose, that in order to remedy these evils, each main gas pipe should be accompanied by another, conveying air from the external atmosphere, ramifying with all the pipes, and discharging its contents by openings alongside of all those from which the inflammable gas issues. The proportion of oxygen in atmospheric air, and the relative proportions of hydrogen and oxygen uniting in the combustion of these gases, require that the atmospheric air tubes and orifices should be as 5, and the coal gas tubes and orifices as 2. If gas pipes were fitted up in this manner, so that every burner should draw its supply of oxygen from the external air, and not from that of the room in which it is burned, the air of the latter would not be so much heated, nor so greatly diminished in purity. I offer these suggestions with great diffidence, and shall wait with anxiety for the opinions of architects on the subject.

We recommend this simple suggestion to our builders and gas-fitters, as a simple, and probably very effective way of ventilating, and one which could be very easily made ornamental to the buildings in which it is introduced. Ed.

On Oxygen. By Prof. Faraday.*

The object of the speaker was to bring before the members, in the first place, M. Boussingault's endeavors to procure pure oxygen from the atmosphere in large quantities; so that being stored up in gasometers it might afterwards be applied to the many practical and useful purposes which suggest themselves at once, or which may be hereafter developed. The principle of the process is to heat baryta in close vessels and peroxidize it by the passage of a current of air; and afterwards by the application of the same heat, and a current of steam (with the same vessels), to evolve the extra portion of oxygen, and receive it in fitly adjusted gasometers; then the hydrated baryta so produced is dehydrated by a current of air passed over it at a somewhat higher temperature, and finally oxidized to excess by the continuance of the current and a lower temperature: and thus the process recurs again and again. The causes of failure in the progress of the investigation were described as detailed by M. Boussingault; the peculiar action of water illustrated; the reason why a mixture of baryta and lime, rather than pure baryta, should be used, was given; and the various other points in the *Mémoire* of M. Boussingault were noticed in turn. That philosopher now prepares the oxygen for his laboratory use by the baryta process. The next subject consisted of the recent researches of MM. Frémy and E. Becquerel "On the Influence of the Electric Spark in converting pure dry Oxygen into Ozone." The electric discharge from different sources produces this effect, but the high intensity spark of the electric machine is that best fitted for the purpose. When the spark contains the same electricity, its effect is proportionate to its length; for at two places of discharge in the same circuit, but with intervals of 1 and 2, the effect in producing ozone is as 1 and 2 also. A spark can act by *induction;* for, when it passes on the *outside* a glass tube

* From the London Athenæum, June, 1853.

containing within dry oxygen, and hermetically sealed, the oxygen is partly converted into ozone. Using tubes of oxygen which either stood over a solution of iodide of potassium, or, being hermetically sealed, contained the metal silver, the oxygen converted into ozone was absorbed; and the conversion of the *whole* of a given quantity of oxygen into ozone could be thus established. The effect for each spark is but small; 500,000 discharges were required to convert the oxygen in a tube about 7 inches long and 0·2 in diameter into ozone. For the details of this research, see the *Annales de Chimie*, 1852, xxxv. 62. Mr. Faraday then referred briefly to the recent views of Schönbein respecting the probable existence of part of the oxygen in oxy-compounds in the ozone state. Thus, of the peroxide of iron, the third oxygen is considered by him as existing in the state of ozone; and of the oxygen in pernitrous acid, half, or the two latter proportions added when the red gas if formed from oxygen and nitrous gas, are supposed to be in the same state. Hence the peculiar chemical action of these bodies; which seems not to be accounted for by the idea of a bare adhesion of the last oxygen, inasmuch as a red heat cannot separate the third oxygen from the peroxide of iron; and hence, also, according to M. Schönbein, certain effects of change of color by heat, and certain other actions connected with magnetism, &c.

Crayons for Writing on Glass. By R. Brunnquell.*

The author prepares crayons for writing on glass, so as to enable the contents of glass vessels to be described immediately upon them in the following manner:—4 parts of spermaceti (or stearine), 3 parts of tallow, and 2 parts of wax are fused in a cup; 6 parts of minium and 1 part of potash are then stirred into it, the mass kept warm for half an hour, and then poured into glass tubes of the thickness of a lead pencil. After rapid cooling, the mass may be screwed up and down in the tube, and cut to the finest point with a knife. A crayon is thus obtained which will readily write upon clean dry glass.—*Dingler's Polytech. Journal*, vol. cxxvii. p. 236.

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, August 17, 1853.

George J. Ziegler, Esq., President, P. T., in the chair.

Isaac B. Garrigues, Recording Secretary.

The minutes of the last meeting were read and approved.

A letter was read from C. F. Losing, Esq., New York.

Donations to the Library were received from The Austrian Engineers' Association, Vienna; The Institute of Actuaries, London; J. L. Losing, Boston, Mass., and from Messrs. C. H. Housekeeper, C. E. Smith, and Prof. J. F. Frazer, Philadelphia.

Donations to the Cabinets were received from Paul Moody, Esq., Camden, N. J., and Mr. John Creech, and Dr. M. B. Smith, Phila.

* From the London Chemical Gazette, No. 254.

The Periodicals received in exchange for the Journal of the Institute were laid on the table.

The Treasurer's statement for July was read.

The Board of Managers and Standing Committees reported their minutes.

New candidates for membership in the Institute (9) were proposed, and the candidates (5) proposed at the last meeting were duly elected.

Mr. G. W. Smith exhibited to the meeting, Polley's globular, elastic, adjustable, and expanding bucket for chain pumps, patented Dec. 14th, 1852, at Washington, and manufactured by H. Vivian & Co., East Kensington, Philadelphia. This bucket is a hollow sphere of caoutchouc, with thick walls; through the centre of the sphere passes a brass rod (with an eye on each projecting extremity), which is cut into a screw, on which traverses a nut and washer; the hollow sphere can, by turning the nut, be compressed so as to form an oblate spheroid of any desirable increased diameter, to fit the bore of the pump with the requisite precision.

G. W. Smith exhibited, at the request of the inventor, Mr. J. Z. A. Wagner, Philadelphia, a "Ship's Speed Indicator." Mr. S. briefly described the method of using the common log at sea, and its defects and advantages; he described, also, several kinds of apparatus which had been used for the purpose of determining the rate of speed of vessels at sea, such as Pitot's bent tubes, revolving vanes, screws, &c., and the various difficulties which have prevented their introduction hitherto. They all, in common with Mr. Wagner's, measure the velocity, or more directly, the pressure of the water at the depth where they are placed; as the velocity of the water near the surface of the ship, and at a little distance therefrom, is not equal, and moreover, varies in every vessel, according to its model, and the varying immersion of its cross section, it is evident that each indicator would require its index to be regulated in accordance with experiments tried with the particular vessel to which it is attached. No opinion was expressed by Mr. S., or by any of the members, respecting this indicator of Mr. Wagner. It consists of a vane attached to the side of the keel, by means of a rod, and folds up when not in use, after the manner of a door; when in use, it projects at right angles so as to receive the pressure of the water: from it rises a vertical stem, which ascends to the cabin or deck, passing, of course, through a stuffing box, the lower end of the rod terminating in a pivot resting in a step; at the upper end is a spring which is bent by the motion of the vane; there is also connected with it at this point, several wheels and pinions and rack, which transfer the movement to the dial or index.

The following remarks by Dr. Kennedy, were omitted in the proceedings of the meeting in July:

Dr. Alfred L. Kennedy invited the attention of the meeting to the many accidents constantly occurring from the insecurity of scaffolding erected around buildings. He regretted that more thought had not been bestowed upon the application of labor-saving machinery in the erection of buildings, and also in their repair. Steam hoisting machines for grain, and steam pile-driving machines had become quite common, but for

elevating bricks and mortar men were yet the main reliance, despite the high price of labor, and the many casualties from the exposure to heat and to falls. The scarcity of lumber produced more economy in the construction of scaffolding. It was a question, however, if some cheaper and more secure means of support could not be devised. In this country, the painter of the front of your house, if it be large, puts you to the expense of scaffolding. In Paris, where all unnecessary risks of life are closely guarded against, where the houses are generally over forty feet front, and six stories high, a wooden platform is seldom or never used in painting the fronts. A strong rope, 1½ to 2 inches in diameter, is firmly attached to the chimney, or other elevated position. This rope is knotted, the knots being about ten inches apart; a board, such as is ordinarily attached to a swing, forms the seat, and is provided at each end with two cords, which, being attached at the corners, unite at a few inches from the board, and are made to terminate in strong iron hooks. The size of these hooks is such, that while they slip readily over the main rope, they are caught by the knots. The length of the ropes is so proportioned that when one hook (say the left) rests on a knot, and the right hook on the knot next above, the board is suspended horizontally; when the painter is seated in place, the rope passes between his knees; his paint-pot is attached by a cord and hook of smaller dimensions. Things being thus arranged, does he wish to raise his seat? he lifts himself from it with his left hand, and with his right removes the right hook to the knot above; he does the same with the left hook, and is then seated ten inches higher than before. In descending, of course the operation is reversed; a little practice gives the workmen surprising ease in changing their position vertically, and by moving to the right or left the point of bearing of the rope on the eave, the change laterally is made with equal facility.

A less simple but exceedingly efficient and convenient apparatus Dr. Kennedy also found in use in Paris. This consisted of two pieces of scantling, fastened together in the form of a cross, the vertical piece being as long as the house to be painted is high, while the transverse arm is but a few feet in length. The inner side of the longitudinal arm is furnished with two blocks of pulleys and ropes; the upper block being firmly attached at the top, and the lower being connected with a windlass, and the seat for the workmen, in such a manner that when seated, the vertical arm shall descend between his knees, and by turning the handle of the windlass he can raise or lower himself at pleasure. The seat is provided with a back, is sufficiently large to receive his pots and brushes, forming, in fact, a comfortable chair. The smaller or transverse arm has a pulley let in at each end, so as to project a short distance from its lower surface, and on these pulleys or rollers the whole rests when in place; the pulleys running in a horizontal grooved piece of joist, which is generally placed along the edge of the eaves, and attached by ropes from the dormer windows or chimneys. The grooved joist is a little railroad, by means of which the whole cruciform apparatus, with its workman, can be easily moved from side to side by an assistant, or pulled by the painter himself, by means of ropes passing from his seat to the extreme lateral window fastenings. The whole, when properly made, will last many years, costs less than a ladder, and may be set up in a few minutes.

JOURNAL

OF

THE FRANKLIN INSTITUTE

OF THE STATE OF PENNSYLVANIA

FOR THE

PROMOTION OF THE MECHANIC ARTS.

OCTOBER, 1853.

CIVIL ENGINEERING.

On the Resistance of the Vertical Plates of Tubular Bridges. By H. Haupt, Civ. Eng.

[Read at the Meeting of the American Association for the Advancement of Science, July, 1853.—Communicated by the Author.]

The great desideratum in the construction of bridges, is an arrangement of parts that with a given weight of material will possess the most efficient powers of resistance.

An arch fulfils the condition of maximum resistance with a given weight of material when the distribution of the load is constant. With a permanent weight, whether uniformly distributed or not, there is a curve of equilibrium, and a given amount or weight of material arranged to conform to this curve, will give the maximum of resistance which the material is capable of opposing.

But for ordinary bridges, especially for railroad purposes, there can be no curve of equilibrium; the load is not only variable, but very great in proportion to the weight of the structure, and were an equilibrium possible in one position, it could remain stable only for an instant, as the transit of the load to another position would at once disturb it.

It is evident, therefore, that the principle of equilibration is applicable only to aqueducts, or other structures upon which the loads are nearly constant, and that to render an arch capable of sustaining a variable load, it must either be made so deep that the variations of the curve of pres-

sure will never pass outside the arch, or it must be combined with a resisting truss capable of effectually opposing any tendency to change of figure.

Most of the bridges in general use are illustrations of this species of combination; but the main reliance is usually placed upon the truss, the arch being used merely as an auxiliary.

When wood is used, this increase of material is not objectionable, except so far as it increases unnecessarily the weight of the structure; but where iron is employed, it becomes essentially important that the distribution of the forces should be understood, the strains upon all parts of the structure accurately determined, and the dimensions correctly proportioned to the required resistances.

The principles involved in these calculations have already been given to the public, in a work on the *General Theory of Bridge Construction*, and no further reference to them is required, except to state that an application of these principles would lead to a radical change in the manner of constructing bridge trusses; and, instead of using an arch as an auxiliary to a truss, the arch would be made the chief dependence, and the truss employed to resist the action of variable loads, and prevent change of figure in the arch during their passage over the bridge. When disposed in this manner, a given quantity of material will oppose an efficient resistance either to vibration, flexure, or fracture.

In tubular iron bridges, which have recently attracted much attention, no difficulty is found in determining the strains upon the horizontal tables, and in proportioning them correctly; but the dimensions of the vertical ribs, and the best manner of stiffening them, will depend not only upon the magnitude of the weight, but upon its mode of application.

If the weight be supposed applied at the middle of a tubular bridge, its action would tend to shorten the diagonal extending from the middle of the top chord or table to the end of the bottom table, and at the same time to elongate the opposite diagonal from the middle of the bottom table to the end of the top table. As the strain upon the last diagonal would be tensile, its ability to resist would be nearly as the strength of the material; but the opposite diagonal, being subjected to compressive forces, would, if it formed a line of a thin plate of metal, be unable to oppose any efficient resistance, and the bridge would probably fail in the direction of this diagonal. It becomes necessary, therefore, to provide means for stiffening the ribs, and this is usually effected by riveting to them vertically pieces of T-iron at short intervals.

By these additions, the distribution of the strains is changed, and the action of the parts is similar to that of a truss on the Pratt plan—the vertical stiffeners taking the place of the posts, and the lines of sheet iron connecting the opposite angle of any panels having a corresponding action to the ordinary diagonal rods.

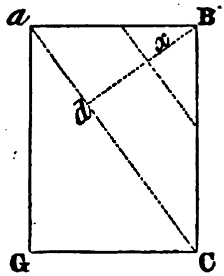
The resistance which such an arrangement is capable of opposing, it is proposed to determine from the following considerations:

In the general theory of bridge construction, it has been demonstrated that where the load is uniformly distributed, the vertical strain increases uniformly from the middle to the ends; the strain upon the diagonal of any panel will be as the length of the diagonal to the length of the verti-

cal side, and also as its distance from the middle of the truss; the maximum vertical strain being of course equal to the whole weight of the bridge and its load, with the momentum due to motion and vibration, when the structure is not rigid.

It has also been shown that the vertical and diagonal strains upon any panel, which are always proportioned to each other in a fixed ratio, are also in proportion to the degree of angular motion or change of figure in any panel caused by flexure, and as the settlement of a bridge to the figure of an inverted arc would not change the rectangular shape of the middle panel, the vertical and diagonal strains upon this panel would be theoretically nothing; while, at the end of the truss, the variation from a rectangle and the intensity of the vertical and diagonal strains would be greatest.

Knowing the whole weight of the structure, the strain upon any panel is readily determined, and it is now proposed to inquire what will be the resistance of a sheet of metal securely attached to all the sides of a rectangle, in comparison with an equal quantity of material arranged in the form of diagonal rods. It is evident that the consideration of this question will afford the means of comparing the relative efficiency of the distribution of the material in tubular bridges, as compared with diagonal panel rods.



Let $a\ c$, in the annexed figure, represent the diagonal which is subjected to a tensile strain, and R the resistance per unit of area which the material is capable of opposing; (a,) its perpendicular distance, B d, from the fulcrum B. The strain upon a unit at the distance x, will be in proportion to this distance, and will be represented by $\frac{R}{a}x$. But as the efficiency of the resistance will be in proportion to the leverage, which is x, the whole effect of a unit of material at the distance x, will be expressed by $\frac{R}{a}x^2$, and the sum of the resistances along the line d B, obtained by the usual method of integration, will be $\frac{1}{3}Ra^2$, or, $\frac{1}{3}Ra + a$. As R represents the resistance of the material per unit of area, and (a) the number of units in the distance B D, R a would represent the resistance of a rod whose area is a, and R $a + a$ its moment of resistance at the distance B d.

As the resistance of the triangle, a G C, is necessarily equal to that of a B C, the whole resistance of the rectangle $a\ b\ c\ g$, will be $\frac{2}{3}Ra^2$. The resistance expressed by $\frac{2}{3}Ra^2$, is obtained by the use of an area of material represented by $a\ c$ + B d. If this same amount of material should be placed in the form of a rod in the diagonal $a\ c$, its cross section must be equal to B D, or a, and its effective moment would be R a^2.

It appears, therefore, that the power of a plate to resist an angular change of figure in a rectangular frame, will be two-thirds as great as that of an equal quantity of material placed in the direction of the diagonal. Where a truss is designed to support a constant weight uniformly distributed, or in other words, where counter-bracing is unnecessary, the adoption

of the tubular or plate arrangement involves an expenditure of 50 per cent. more material than would be required by diagonal rods; but where the load is variable, as is always the case in bridges, and where rods are consequently required in both diagonals, the relative economy of the two arrangements is more nearly equal, and may even be reversed. In a truss which is unsupported by an arch, a calculation of the quantities of material required in the two arrangements involves a consideration of the strains produced by the variable and constant loads in each panel. In the middle panels, the strain from the weight of the structure being theoretically nothing, the diagonals resist only the effects of the variable load, and must be equal. If the area of each rod be represented by $\frac{2}{3}a$, the two would be $\frac{4}{3}a$; but as the braces and counter-braces are never both in action at the same time, the plate arrangement requiring a quantity of material represented by (a,) would be equivalent to the braces and counter-braces both, and would effect a saving of material equal to $\frac{1}{3}a$. *The rods in this case would require 33 per cent. more material than the plate.*

If $\frac{2}{3}b$ represent the material required in the rods of the end panels to resist the weight of the structure, then $\frac{2}{3}b + \frac{2}{3}a$, would be required for the main diagonal rods, and $\frac{2}{3}a$ for the counter-brace, making $\frac{2}{3}b + \frac{4}{3}a$. The plate arrangement would require $b + a$. The difference is, $\frac{b - a}{3}$. Hence, if a should be equal to b, the value of the expression becomes zero, or in other words, *if the variable and constant loads are equal at the end panels, the quantity of material in the rods and plates will be the same;* but if the variable load is least, there will be a loss of material by the use of the plates, which will be greater as the weight of the structure increases, and, consequently, *the relative economy of plates would be less for very long spans than for shorter ones.*

These considerations naturally lead to the substitution of sheet iron for the rods of wooden bridges, and its adoption will secure the essentially important advantages of simplicity, economy, incombustibility, and durability, if practical difficulties do not arise from the expansion and contraction of the plates when attached to wooden frames. As the expansion of diagonal rods is not found to be productive of any injury or inconvenience, it is possible that the slight bending or buckling which must result from the expansion of the iron plates, might not lead to any serious consequences; but whether the plan of constructing bridges by covering wooden frames with sheet iron be practicable or not, the result of the calculation that has been given proves that with a sufficient number of posts or stiffeners, the vertical plates in tubular iron bridges may be very thin, and still possess sufficient powers of resistance—a conclusion, the truth of which is confirmed by the experiments on the Britannia Bridge.

A tubular iron bridge without arches, to be properly proportioned, should have the number or thickness of the top and bottom plates increased, and of the side or vertical plates decreased gradually from the ends to the middle. A tubular bridge in which the plates are of the same dimensions in the middle and at the ends, must be very badly proportioned, and contain a large amount of useless material.

If v represent the variable load upon a single panel or interval between

two adjacent posts or stiffeners, n = number of panels, w the whole weight of the structure, then the proportion between the thickness of the vertical plates in the middle and at the ends, will be nearly as v, $\frac{n v + w}{2}$; as this proportion may readily be as great as 1 : 5, it follows that a very great saving may be effected by proportioning the thickness of the sheets in each panel to the strains, an arrangement that appears to have been overlooked or neglected in the construction of tubular bridges.

For the Journal of the Franklin Institute.

Experiments on Screw Propellers in H. B. M. Steamer Minx. By B. F. Isherwood, Chief Eng., U. S. N.

In 1847 and 1848, there were made by order of the British Admiralty, experiments on a number of screws applied to H. B. M. Steamer *Minx;* and I find in *Bourne's Treatise on the Screw Propeller*, a table of these experiments, for the first time published. This table appears to me, in the condition in which it is given, to be of but little value to the practical engineer, and liable, without careful discrimination, to mislead him. It is accompanied by no account of the manner in which the experiments were conducted, no classification is attempted, nor are there any deductions drawn. I have, therefore, selected from those experiments in which the results are consistent with each other and with the nature of things—rejecting anomalies—such of the observed elements as were not contradictory, and from them have made my own calculations and drawn my own conclusions.

The *Minx* was a vessel of the following dimensions, viz:

Length of hull between perpendiculars,	131 feet.
Beam, extreme,	22 " 1 inch.
Draft, mean,	5 " 2½ "
Immersed amidship section at 5 feet 2½ inches draft,	82 square feet.
Displacement at 5 feet 2½ inches draft in tons of 2240 lbs.,	203.

The machinery consisted of two vertical, oscillating, condensing engines, geared so as to give the screws four revolutions for each double stroke of engines' pistons.

Diameter of the cylinders,	34 inches.
Stroke of pistons,	2 feet 9 "
Space displacement of both pistons per stroke,	34·678 cubic feet.

The trials were made in the Thames river, at a measured geographical mile of 6082⅔ feet; the vessel being kept throughout at nearly the same draft of water.

The mean gross steam pressure in the engines' cylinders was ascertained by an indicator, and the dynamometer was applied to obtain the thrust of the screws. Now, the dynamometer measures simply the power applied to the propulsion of the vessel; that is, it measures that part of the total engine power which is expended in giving motion to the hull; and as it is evident that with the same vessel, under the same circumstances, greater speed can be obtained only by the application of greater

power to the hull, and greater in proportion to the cubes of the speeds, it follows that the dynamometer powers should be sensibly in the proportion of the cubes of the speeds within moderate limits: but the results, as given, show not only no fixed relation of the dynamometer power to the speed, but frequently a much less speed, accompanied by a much greater power; the dynamometer results must, therefore, be entirely rejected as erroneous.

The given number of revolutions made by the screw per minute, can doubtless be depended on as exact; and the steam pressure in the cylinders, as given by the indicator, can probably be depended on, not as strictly accurate, but as a pretty close approximation to the truth, as I find by testing, that in general the revolutions of the same screw in equal times, are nearly in the ratio of the square roots of the piston pressures, which should be the case.

The element most liable to error, and of the greatest importance, because its third power enters in the comparisons, is the speed of the vessel; an element obviously the most difficult to determine with exactness.

As the speed of the vessel for the purpose of comparison must be the speed in smooth water, uninfluenced by wind, current, steering, or unequal fouling of the bottom, and as these causes vary on every trial, and as it is impossible to ascertain their effects accurately, there must always be *some* error in the element of speed—an error which can only be reduced to an insensible amount by taking the mean of a large number of trials; the greater the number the less will be the error. In the experiments with the *Minx*, the number of trials made with each screw appears to have been too few, and it would have been more satisfactory had the final results been the mean of a greater number of observations.

The distance run of one geographical mile was too short, as the slight error of only a few seconds in the times of passing the stakes at each end of the course, if made in the same direction, would wholly vitiate the result; for instance, the true speed of the vessel being supposed 8 miles per hour, there would be required 7½ minutes to run one mile; now, if an error of only 5 seconds be made in the time at each stake, being called that much too late at commencing, and that much too soon at stopping, making an error of 10 seconds in all, then the mile, instead of being run in 7½ minutes, would appear to be run in 7⅙ minutes, and the vessel's speed, which was really 8 miles per hour, would be given as 8·37 miles per hour; and as the cubes of the speeds are the measures of the effects, this discrepancy would become enormously exaggerated in the final result.

No drawings or descriptions being given of the screws tried, it is impossible to know their exact configuration; they were probably of uniform length from the hub nearly to the periphery, and the helicoidal area was made equal, or nearly so, in the several screws, by "*cutting off the corners*," as it is termed in *Bourne's Table of the Experiments*. It is not stated whether the areas of the screws, as given in this table, are the projected areas on a plane at right angles to the axis, or the helicoidal areas; they cannot, however, be the former, as they are too large, even on the supposition that the length was uniform from hub to periphery. The screws experimented with were all two-bladed, and of the same dia-

meter, viz: 4 feet 6 inches. They consisted of four series: 1st, Screws of uniform pitch. 2d, Screws of expanding pitch fore and aft, but of uniform pitch radially. 3d, Screws of expanding pitch radially, but of uniform pitch fore and aft. 4th, Screws of expanding pitch both fore and aft and radially. Each series will be considered separately.

Screws of Uniform Pitch.—The screws of uniform pitch were three in number, and had pitches of 5 feet 10 inches, 5 feet 6 inches, and 5 feet, which screws I shall call respectively A, B, and C. The screw, A, was modified by successively reducing its length by a plane at right angles to the axis, and experiments were made to ascertain the effect of each reduction.

With screw, A, (before modification,) six trials were made. Of these, the first two, made on the 4th and 5th June, 1847, I reject, as the results are too greatly inconsistent with the general results of the experiments, and too widely differing from the results of the last four trials, which closely agree with each other and with the general results; I therefore accept them. The mean of these four trials gives a slip of 37·3 per cent., from which the extremes do not differ 1 per cent.

The first modification of screw, A, was made by reducing its length from 1 foot to 10 inches, and its helicoidal surface from 7·1 square feet to 5·97 square feet. The mean of three trials with this modification gave a slip of 39·6 per cent., from which the extremes differ by only $\frac{2}{10}$ths of 1 per cent. This reduction in the length of the screw caused an increase in the slip of 2·3 per centum absolutely, or $\left(\frac{39{\cdot}6 - 37{\cdot}3 \times 100}{37{\cdot}3} = \right)$ 6·2 per centum relatively; or, in general, decreasing the surface one-sixth increased the slip one-sixteenth.

The second modification of screw, A, was made in the same direction and in the same manner as the first one, by cutting off 2 inches more, which reduced the length of the screw from 1 foot to 8 inches, and the helicoidal surface from 7·1 square feet to 4·93 square feet. With this modification, two trials were made, of which I reject the first, made 9th July, 1847, as the result is obviously erroneous; I accept the last trial, which gives a slip of 41·7 per centum. This reduction in the length of the screw caused an increased slip over that of screw, A, of (41·7 — 37·3 =) 4·4 per centum absolutely, or $\left(\frac{41{\cdot}7 - 37{\cdot}3 \times 100}{37{\cdot}3} = \right)$ 11·8 per centum relatively; or, in general, decreasing the surface one-third increased the slip two-seventeenths.

A further experiment was made August 17th, 1847, in the same direction and manner, by reducing the length of the screw to 6 inches. Only one trial was made, and the result is so manifestly erroneous that I reject it.

With screw, B, two trials were made, of which I reject the last, made July 1st, 1848, as its result is greatly inconsistent with the general results. I accept the first trial, which gave a slip of 34·8 per centum.

With screw, C, three trials were made; the mean result gave a slip of 31·6 per centum, from which the extremes do not differ 1 per centum.

The following table exhibits in detail the data and results of the Screws of Uniform Pitch:

Designation of Screw.	Date of Trial.	Vessel's draft of water in ft. and in. — Forward.	Aft.	Mean.	SCREW. — Diam. in feet and inches.	Pitch in feet and inches.	Number of blades.	Length in direction of axis, in inches.	Helicoidal area, in square feet.	Number of revolutions made per minute.	Slip of the screw in per centums of its speed.	ENGINES. — Gross average pres. in the cylinders in lbs. per sq. in.	No. of double st'ks. of engines' pistons made per minute.	Horse power developed by the engines.	Speed of the vessel per hour in knots of 6082⅔ feet.
A.	Sept. 4th, 1847.	4 6½	5 10½	....	4 6	5 10	2	12	7·1	216·7	36·8	10·12	54·18	....	7·882
	" 17, "	4 6½	5 10½	....	4 6	5 10	2	12	7·1	218·7	37·7	10·17	54·68	....	7·843
	June 30, 1848.	4 5	6 1	....	4 6	5 10	2	12	7·1	231·3	36·5	11·89	57·83	....	8·445
	July 12, "	4 5	6 0	....	4 6	5 10	2	12	7·1	256·9	38·2	12·97	64·23	....	9·130
	Means,	4 5¾	5 11½	5 2⅝	4 6	5 10	2	12	7·1	230·9	37·3	11·3	57·73	197·42	8·325
1st Modification of A.	Sep. 16, 1847.	4 7	5 10½	....	4 6	5 10	2	10	5·97	215·8	39·4	8·83	53·96	....	7·521
	" 17, "	4 7	5 10½	....	4 6	5 10	2	10	5·97	232·0	39·7	10·12	58·00	....	8·043
	July 1st, 1848.	4 5	6 0	....	4 6	5 10	2	10	5·97	252·0	39·5	12·26	63·00	....	8·765
	Means,	4 6⅓	5 11	5 2⅝	4 6	5 10	2	10	5·97	233·3	39·6	10·40	58·32	183·56	8·110
2d Mod. of A.	Sept. 17, 1847.	4 6½	5 10½	5 2½	4 6	5 10	2	8	4·93	237·8	41·7	9·91	59·45	178·30	7·972
B.	June 30, 1848.	4 5	6 0	5 2½	4 6	5 6	2	12	7·1	240·6	34·8	11·44	60·14	207·48	8·514
C.	Sept. 17, 1847.	4 6½	5 10½	....	4 6	5 0	2	12	7·2	249·8	32·2	9·95	62·44	....	8·354
	July 1, 1848.	4 5	6 0	....	4 6	5 0	2	12	7·2	262·0	31·6	12·00	65·49	....	8·844
	" 12, "	4 5	6 0	....	4 6	5 0	2	12	7·2	250·1	30·8	10·22	62·52	....	8·531
	Means,	4 5½	5 10½	5 2½	4 6	5 0	2	12	7·2	254·0	31·6	10·70	63·48	205·56	8·576

If, now, we compare the pitches of screws, A, B, and C, (which are similar screws in all respects save pitch, having equal diameters, helicoidal areas, length and number of blades,) with their slips respectively, we shall find that the slips are sensibly in the direct ratio of the pitches, as appears from the following:

	Pitches.	Slips.
Screw A,	5·833, or 1·167	37·3, or 1·180
Screw B,	5·500, or 1·100	34·8, or 1·101
Screw C,	5·000, or 1·000	31·6, or 1·000

That this should be the truth, is manifest from the consideration that the rotary velocity of similar screws with unequal pitches to advance equal distances in equal times, is in the direct ratio of the pitches; and as the moment of pressure is as the rotary velocity, it follows that the resistances of equal screw surfaces will be as their rotary velocities, *i. e.*, as their pitches inversely, the lesser pitch having the greater resistance.

There remains to determine the relative economical efficiencies of the screws of uniform pitch. For this purpose, the horse powers developed by the engines will be taken as the expressions for the powers, and the cubes of the vessel's speed for the measures of the effects. The effects being divided by the powers, the quotients will represent the relative economical efficiencies.

	Powers.	Speeds.	Effects.	Relative economical efficiencies.
Screw A.	197·42 or 1·0000	—8·325 or 1·0000	and $1·0000^3=1·0000$	and $\frac{1·0000}{1·0000}=1·0000.$

1st Modification.

	Powers.	Speeds.	Effects.	Relative economical efficiencies.
Screw A.	183·56 or 0·9298	—8·110 or 0·9741	and $0·9741^3=0·9244$	and $\frac{0·9244}{0·9298}=0·9942.$

2d Modification.

	Powers.	Speeds.	Effects.	Relative economical efficiencies.
Screw A.	178·30 or 0·9032	—7·972 or 0·9576	and $0·9576^3=0·8781$	and $\frac{0·8781}{0·9032}=0·9722.$
Screw B.	207·48 or 1·0509	—8·514 or 1·0227	and $1·0227^3=1·0700$	and $\frac{1·0700}{1·0509}=1·0182.$
Screw C.	205·56 or 1·0412	—8·576 or 1·0301	and $1·0301^3=1·0930$	and $\frac{1·0930}{1·0412}=1·0498.$

From the above we perceive that with similar screws, omitting the modifications of screw A, there resulted an *increased* efficiency from each *decrease* of the pitch. This increased efficiency could only have arisen from the decreased slip of the screws with lesser pitches, and as the helicoidal areas of the screws were the same, the frictions of the screw surfaces on the water must have been nearly equal, but a little greater with the screws of lesser pitch, on account of their greater helical speed. Now, as slip is a measure of the loss of useful effect, that loss should be in the direct ratio of the slip, as will appear from the following considerations:

As pressure and resistance are equal and in opposite directions, a pressure equal to the resistance of the vessel is always experienced by the water on which the screw acts propulsively; but the amount of power expended is proportional to the resistances moved and the distances through which they are moved in the same time. Now, supposing the screw to slip or recede one-fourth of its pitch per revolution by the yielding of the water on which it acts; that is to say, that per revolution it moves the vessel through but three-fourths of the pitch, instead of through the whole pitch, as it would do were there no slip; and, as pressure and resistance are equal and in opposite directions, there is the same pressure exerted by the screw upon the receding water as there is exerted by it on the advancing vessel; but in the supposed case of slip, the water acted on or pressed by the screw is moved a distance that can be represented by 1 in the same time that the vesseel is moved a distance that can be represented by 3, the whole distance moved being represented by 4, equal to the pitch of the screw. Calling the pressure on the engine piston 1, the total power developed by the engine can be represented by $1\times4=4$, of which $1\times1=1$ represents the amount expended on the slip, or one-fourth of the total power for a slip of one-fourth; while $1\times3=3$ represents the amount of power expended in overcoming the resistances of the vessel, or three-fourths of the total power developed. It is thus plain that the loss of useful effect caused by slip, is as the slip. It must be distinctly understood that the loss of useful effect *caused* by a slip of 25 per cent. is 25 per cent. of the gross or total power developed by the engines, and not 25 per cent. of what remains of the total power, after

deducting those fractions of it required for working the engines alone, and overcoming the friction of the load; for it is evident that at each revolution, 25 per centum of the power required for working the engines alone, 25 per centum of the power required for overcoming the friction of the load, 25 per centum of the power required for overcoming the friction of the screw surface on the water, and 25 per centum of the power required for propelling the simple hull, making a total of 25 per centum of the whole power developed by the engine, is lost by slip; for, by consequence of the slip, each of these fractions or divisions of the total power has to be exerted 25 per centum longer to produce the same result; that is, to cause the vessel to go the length of the pitch instead of the length of three-fourths of the pitch, than would be required were there no slip; and although, to make a revolution in the same time with slip, requires less piston pressure than to make the same revolution without slip, yet the useful effect will also be proportionably less, as the vessel will be driven in the same time through a less distance by the amount of slip. To obtain the same useful effect, that is, to drive the vessel through equal distances in equal times, the engines in the case of slip must be worked at a proportionably higher speed, which again requires a proportionably higher piston pressure, so that to drive the vessel equal distances in equal times, with and without slip, the piston pressures will have to be the same, but the speed of the engine, and consequently the power exerted, must be greater in the direct proportion of the slip.

On the above reasoning, we should find the relative efficiency of the different screws with equal surfaces to be sensibly in the proportion of the slips. Applying this, the following appears to be the correspondence:

Screw C has 3·2 per centum less slip than screw B, and 3·1 per centum more efficiency.
" " " 5·7 " " " A, " 5·0 " "
" B " 2·5 " " " A, " 1·8 " "

In the case of the same screw with reduced surfaces, this law will be modified, from the fact that the reduced surface has decreased the amount of friction of the screw on the water; therefore, the relative efficiency of the same screw with decreased surfaces will be in a higher ratio than the ratio of the slips. Applying this, we have the following:

1st Modification.

Screw A has 2·3 per centum more slip than screw A, and 6·1 of 1 per cent. less efficiency.

2d Modification.

Screw A has 4·4 per centum more slip than screw A, and 2·9 per centum less efficiency.

1st Modification.

Screw A has 4·8 per centum more slip than screw B, and 2·4 per centum less efficiency.

2d Modification.

Screw A has 6·9 per centum more slip than screw B, and 4·7 per centum less efficiency.

1st Modification.

Screw A has 8·0 per centum more slip than screw C, and 5·6 per centum less efficiency.

2d Modification.

Screw A has 10·1 per centum more slip than screw C, and 8·0 per centum less efficiency.

To be Continued.

*Comparison between English and American Railway Management.**

At a time when a parliamentary committee is sitting on railway policy, it appears opportune to bring before shareholders whatever evidence is calculated to assist in arriving at correct conclusions. The position of railway administration in England at the present moment is this: it is assumed by railway directors to be perfect; its perfection is very much doubted by shareholders and the public. The former have an idea that every care is not taken for economy, the latter that every care is not taken for public safety. The directors claim implicit confidence in their management, on account of the purity of their motives; the shareholders think that every respect may be paid to motives, but that a salutary investigation may be made into the details of management. We have always upheld this principle, and acting upon it we shall take advantage of an important public document just issued in the United States, to institute a comparison between English and American management. The extravagance of one line may be defended or palliated by the greater extravagance of another line; but the experience of a remote system may be accepted as impartial evidence, and it may better guide us in arriving at results. Here a certain set of engineers have given the same general character to the railway system and management; the school of Stephenson has become the school of England, and there has been little disposition to authorize anything which did not bear the stamp of legitimacy, as authoritatively imposed by the arbiters of railway expenditure. In the United States it has been different; there has not been that blind following of the high and mighty in engineering, and as there has not been a body of open-mouthed and open-pursed shareholders to draw upon, unlimited economy, and it may be said necessity, has in many cases been allowed to have some voice. Hence we may expect to get some evidence, which, though not arising from identical circumstances, may throw light on the case, or even, as being of a negative character, may determine the course of the investigation.

The documents before us are included in the report of Mr. McAlpine, the State Engineer of New York, in pursuance of a recent law that passed in 1850, and although the operation of the system of returns is not yet complete, a large mass of valuable statistical information is brought together, and the deductions are very carefully drawn. When we state that the length of railways embraced in these returns is between 1800 and 2000 miles, it will be seen the extent is ample for comparison. The circumstances, too, of New York State admit of a better comparison than those of other parts of America. The country is not throughout so thickly peopled as England; but there is a metropolitan population in New York City of 600,000, and there are many populous towns. There are districts approaching Scotland and Wales in population, and there are large seats of manufacture, and in some places an enormous transit trade. Thus there is a great variety of character in the traffic conditions, in some cases approaching those of our wealthy and thriving districts, in others going as low as the poorest parts of the Highlands or Welsh

* From Herapath's Journal, Nos. 732 and 733.

mountains. Some might reject the comparison for these latter circumstances, but they are indeed those which claim most attention. In these islands a total population of 30,000,000 have 7000 miles of railway; in New York a population of 3,000,000 have 2000 miles of railway. This is a proposition not lightly to be set aside without investigation. In Ireland 6,000,000 of people have one-third of the length of railway possessed by half the population in New York, or one-sixth of the supply. The case of Scotland is generally better, the same population as New York having half the length of railway.

The passenger traffic on 1900 miles of railway in 1852 was 7,440,653, and the number of miles run, 343,358,545, which gave an average mileage per passenger of 46 miles. In 1851, the average distance travelled by each passenger was 47 miles; so that from discrepancies in the returns some of the figures must be received with caution; but this may be taken as a fair average. This rate is far above the European standard, as the average rate in England and Belgium is only about one-half of the above. The American returns include little of what is known as short or omnibus traffic; while from the great extent of the country and the widely scattered population, for which railways afford the most convenient transit, the distance of the journeys is greater than here. The returns likewise include a large proportion of through emigrant traffic to the far West. The average suggests some interesting reflections; first, that the American traffic is not to such a great proportion as ours intermediate; and, second, that a railway system can be carried out where the average mileage of each passenger is 46 miles, as must be the case in some thinly peopled colonies and countries requiring great length of railway. This illustration will be found useful in reference to the Canadian railways, the traffic of which is little understood here.

The average speed of the passenger trains is given as 26½ miles per hour, but this seems to be the speed without stoppages. At any rate, it is not a very high speed, but it is found suitable for a large proportion of the traffic. In this country, the question has been little considered how far low speeds and cheap fares can be made to work profitably, except so far as the Irish lines are concerned, though there the tendency is towards increasing the speed. In New York the emigrant traffic to Canada and the West is carried at very low rates, and it is contemplated to do the same on the Great Canadian trunk.

The average number of passengers in a train is returned at 77·6, the number of trains per day being generally much less than in this country. The great endeavor in the United States is to give the public low fares, and the Companies a low rate of expenditure, and every thing is directed upon these two principles, which are made to work together. By running few trains, at reasonable speeds, and by attending to the construction of the carriages, much economy is obtained. The American carriage being, as is well known, on a larger scale than here, and allowing of internal communication, admit of being worked cheaper with respect to the staff on the line and in the stations, and is effectively more convenient to the public than the English railway carriage. This is a subject well worthy of inquiry, as much of the economy of American railways depends upon it, but at present we can only briefly refer to it. The effect is to reduce

the expenses of fixed stations, and to allow of passengers being worked from places where, on the English system, a station could not be maintained. Instead of a staff distributed over twenty stations, as here, the staff in America travels with the trains, and the stations, buildings, and equipments are consequently of a minor character. On the other hand, whenever it is desirable to set down or take up a large or small number of passengers at a given spot not usually worked to as a station, nothing is necessary but to stop the train, like an old stage coach, and the requisite station staff is forthcoming. There are many places where there is a market traffic once a week, for which a fixed station staff would be required on such occasions, and with the privilege of keeping their hands in their own pockets, and dipping into the pockets of the shareholders the greater part of the week, and which must in England be neglected or worked at a loss. Of course, a staff proportional to the trains will, nevertheless, be at times in excess of the traffic, but by no means correspondent to a fixed station staff.

The element of cost, we have frequently had occasion to point out, is the foundation of traffic working, upon which depends the relation of returns to expenditure, and to a great degree the realization of a dividend. It is true enough, that where there is an enormous traffic it may be able to meet an enormous outlay for construction; but on the other hand, a moderate outlay is safer to receive a return.

We have shown that the length of line in New York State is far above our standard, and we may observe that it brings a very handsome return, and this in a thinly peopled country. The whole cost, however, of 1819 miles is $84,034,456. For the reduction of the various sums from American to English values, we shall take the dollar at 50d.; that is, the cent at one halfpenny, which is sufficient to meet the requirements of the case, and which will give us as the whole cost 17,500,000*l.* The average cost per mile of a single line of rails is $36,701, or 7500*l.* Upon the question of comparative cost, we shall not now dwell, only so far as it influences the question of fare.

It is obvious that lines costing 7500*l.* per mile can carry much cheaper than lines that cost five or eight times as much, unless the latter are qualified to carry a greater traffic. A double line effects this, but still there is the difference between 15,000*l.*, the American standard for a double line, and the much larger cost of most of our English lines. We take the cost of a double line at double tha single track, which we believe is about fair in the United States. If then a double line in the United States would cost 15,000*l.*, it can carry at one-third the fare of a line costing 45,000*l.*, and pay as good a profit, and it is this question of fare which, as a further step in the progress, influences traffic.

The working of a limestone quarry is as good an example for working out traffic sums as can be found. Taking the cost of the limestone at five shillings per ton, and the price which the farmer or other consumer can afford to pay, or that which is limited by competition, to be ten shillings, then five shillings remaining for cost of conveyance, the distance to which the lime can be carried will be limited by the rate of conveyance. If the rate be sixpence per mile, then the stone can be carried only 10 miles; if threepence, 20 miles; but if one-penny, then 60 miles. To the carriers

it may seem indifferent whether they carry the stone ten miles or sixty, seeing that they receive in either case five shillings; but if they truly look at their interests, it will suggest itself that the lowest fare which is remunerative to them is the one which will bring the greatest return. With a distance run of ten miles, the area of consumption and distribution will be over a circle of ten miles radius, or 20 miles diameter; but with a distance run of 60 miles or 120 miles diameter, the area would be vastly increased. Practically, of course, the whole theoretical area is not obtained, because there are natural or other bounds to traffic. Thus, in the case cited, a neighboring stone quarry will constitute a bound at five miles' distance, though in other directions the radius may extend to 60 miles. The object, therefore, practically, is so to adjust the rate of conveyance as to secure the maximum amount of income and of profit. We need scarcely say that traffic managers in this country are seldom guided by such considerations. At one time they put on prohibitory high rates on articles which will not bear them; at other times they engage in foolish competition with other companies, and put unremunerative rates on articles which can bear any amount of charge, and do not feel the benefit of the reduction.

With regard to passengers, applying the above principle is equally applicable, though the form is varied. Traffic managers can understand that coal and limestone are influenced in their consumption by the rate of charges, inasmuch as they proceed from a place; but they do not seem to understand the converse, how when the traffic goes to a place, the same law operates. Let us take the case of Birmingham or Cheltenham. The consumption of Birmingham goods is general throughout the country, and the tradesman will resort to Birmingham if he can do so with advantage to himself. This depends upon the rate of fare added to his other expenses, and being part of the margin of profit or loss on his operations. If ten shillings be the amount which he can afford to spend on traveling to Birmingham, he will travel so far as ten shillings will carry him, and this depends on the railway companies; beyond that sum he will not travel at all. Pleasure traffic is not of the same precise nature, but is dependent on the same general law, and the area of the Cheltenham traffic is as much dependent on the rate of railway fare as its yearly fluctuation is on the state of the country.

It will be seen that from certain districts a railway will receive no income at all, nor can it receive any unless its rate of fare will make it remunerative or practicable to the traveler. The hardwareman or ironmonger will visit Birmingham, Sheffield, or Wolverhampton, and the clothman will visit Leeds or Bradford, if his transactions will bear it, and not without; and we need scarcely say that as matters stand, the tradesman in the north of this island, or in the provinces of the sister island, does not think of visiting the places named for purposes of business.

The development of passenger traffic affects goods traffic in most articles, and the two work together, so that moderate passenger fares are of more importance than moderate goods rates. Coal, it is true, may be sent to market in hundreds of thousands of tons with little personal supervision; but all kinds of merchandise and parcels traffic require much personal intercourse, and this, notwithstanding cheap rates of postage and

telegraph communications. Looking at all these circumstances, we cannot but feel that railway traffic in this country is far from bearing its full results, and has not reached a complete development.

The traffic of the United States rests, it will be seen, on a sound basis, so far as the cost of line is concerned, for it is not difficult to get a traffic for a line costing 7500*l.* a mile, even though the per centage of working should prove very high. Upon such a cost we may expect low fares, and indeed we find them.

On a very few lines in New York, and those short ones only, do we find a first class fare of 1½d. This is the maximum, and seems to be an enormous rate. The ordinary first class fare is our parliamentary one of one penny per mile. What do our chairmen and shareholders, who exclaim against parliamentary trains, and call out for high fares, think of that? Let them imagine, if they can, the practicability of working a railway at such fares, paying 6 to 7 per cent. on debenture debt, and higher dividends. Incredible as they may think it, it will be done in these countries as well as by our brethren beyond the Atlantic, and although engineers pronounce it impossible to make cheap lines, there will be plenty of them before many years are over.

Second class fares, properly speaking, are not found on most of the lines, the first class fares being so moderate that a uniform rate can be charged, and there is no necessity to talk of turning decent coated men out of second or third class carriages, adopting dirty tricks to prevent the public from traveling according to their means, or for turning mechanics and their wives into hog-pens. The lower class fares are chiefly for emigrants and negroes, and they go down low enough in all conscience. A great quantity of traffic is carried at 0·50d., 0·48d., 0·40d., and even at 0·37d. Here are rates for the consideration of traffic committees, though perhaps gentlemen who hold their hundred thousand pound stock in one line may not believe that there are persons among their fellow countrymen to whom a few shillings are as great an object as their guinea attendance fee is to them.

Let it not be imagined that the American lines are only short lines, having no scope for through traffic. They have short lines, it is true, upon which generally the highest rates are charged; but they have lengths of line in comparison with which our London and North-Western route falls into the shade. The New York and Erie Railway, in its main line, from Piermont to Dunkirk, is 446 miles long, or nearly as far as from London to Perth. The lowest fare from London to Perth, 452 miles, is 30s., and this is likewise the lowest fare to Edinburgh and Glasgow, 405 miles. The third class fare on the New York and Erie Railway is 15s., or half that amount. The first class fare is 37s., or little more than that amount, so that wealthy and working classes are equally well treated. The first class London and North-Western to Perth is 79s. 6d., and the express 87s. The New York and Erie ordinary rate, including stoppages, is 21 miles; what the London and North-Western is for third class passengers to Perth, we cannot make out; that for first and second class passengers seems to be about 22 miles per hour. The New York and Erie express rate is 27 miles, including stoppages, and the fare only first class fare. The London and North-Western rates to Perth are 26 miles and 30 miles

per hour, the fair as above given; therefore, we have not much to boast of in the way of accommodation. It is not to be wondered at if the average mileage of a New York passenger is twice that of an English passenger.

A peculiarity on some of the American lines is, that they charge higher rates for intermediate, or, as they call them, way passengers. This is on account of the greater average mileage.

On Improved India Rubber Springs for Railway Engines, Carriages, &c. By Mr. William C. Craig, of Newport.*

In order to explain the difficulties which have been contended with and surmounted by the use of these springs, the condition of the roads upon which they have produced such satisfactory results has to be noticed, and the causes which first led to the introduction of india rubber as a substitute for steel, in bearing springs, buffers, and draw springs.

The Western Valleys Lines of the Monmouthshire Railway and Canal Company (upon which the writer is locomotive superintendent), consist of twenty-five miles of tramway, exclusive of branches, and worked by heavy coupled engines of the most improved construction. The tram-plate is laid by means of chairs upon transverse sleepers, about 3 feet apart, and an intermediate sleeper at the joints. This plate, although heavy (about 73 lbs. per yard), is of very weak section, and there is, consequently, considerable deflexion in it, a tendency to rise at the joints, and for the sleepers to work loose: the effect of this is, to cause a much greater expenditure of power necessary to overcome a series of rising and falling gradients, than would be the case upon an edge rail; and an undulatory motion of the engine is caused, which is extremely destructive to the steel springs hitherto in use on this line. The curves are unusually sharp, (some being under five chains radius, and the majority under twenty chains,) which is productive of a prejudicial effect on the wheels, buffers, and other parts of the engines, carriages, and wagons. The gradients are very heavy, (some being 1 in 54,) producing a much greater strain on the draw-bars and couplings than is to be met with upon ordinary railways.

Upon such a road, the inconveniences attending the use of steel springs were both numerous and formidable. In addition to the continual repairs which were required by the springs themselves, the injury done to the permanent way, arising from the unequal action of the spring, and the violent concussions they were subject to, when they were totally disabled (as was frequently the case), was large in amount, and of continual occurrence, and of a character that involved considerable expense in repairs. Some idea of the damage thus occasioned may be formed, from the fact of the wheels tyres requiring to be replaced at least every eight months, having become worn by that time into a series of flats, more nearly resembling an irregular polygon in outline than the circumference of a circle.

The engine tyres used on the tramways are steeled on the wearing surface. With regard to the springs themselves, it may be proper to mention here, that the item of expenditure for steel springs (including wages for

* From the London Repertory of Patent Inventions, July, 1853.

repairing them) was 251*l.* 9*s.* 9*d.* in six months, for fifteen engines only. Such, then, were the circumstances when it was deemed necessary to test the application of india rubber to the various purposes before mentioned, and the results have been attended with such marked success, as to exceed the most sanguine anticipations entertained.

The india rubber springs described in this paper are constructed on Mr. Coleman's plan; one form of which, as applied to engine-bearing springs, consists of a cylinder of prepared india rubber, 9 inches long and 9 inches in diameter, with a hole through it of 1¾ inch for the spring pin; it is supported by a wrought iron plate 1⅛ inch thick, which rests on a shoulder on the spring pin, and is covered by a wrought iron plate and cross-bar, through which pass the spring links attached to the outside framing at the bottom, and secured by set and jam nuts at the upper end. The india rubber is prevented from undue lateral expansion by two ¾-inch round iron hoops, and from internal compression and friction on the spring pin, by a helical coil of strong wire; instead of this wire, wrought iron ferrules are now used. To obviate an inconvenience which has been occasionally complained of, in passing over unusually rough portions of the road, viz: the jumping motion of the engines, from the great elasticity of the springs, it was found necessary to insert between the bottom plate and the top of the framing, another smaller cylinder of india rubber, for the purpose of absorbing the recoil of the spring, and to prevent any motion being re-communicated from the spring to the framing. This had the desired effect, and the engine was found afterwards to run uniformly steady, at all varieties of speed, and however great the inequalities of the road.

Upon engines with inside framing, or where sufficient space for the springs could not be obtained, two cylinders, or sometimes three, were used.

In the application of the same description of spring to a tender, the india rubber is 6½ inches diameter, 7 inches long, with a 1¾-inch hole, and bears against a cast iron bracket bolted to the frame work of the tender—the bottom plate being supported by a set nut on the spring pin, which passes loosely through a hole in the under side of the bracket, and rests on a wrought iron plate, ⅝ inch thick, made to fit in the top of the axle-box,

A similar arrangement may likewise be applied to wagons. In the passenger carriages, two of these springs are used in pairs, in order to obtain a greater amount of elasticity, without increasing the distance between the centre of the axle and the sole bar, and a modified form of axle-box is introduced, to meet the requirements of the double cylinder of india rubber. No horn plates are used in this case—their place being supplied with two guide-rods, which pass through the axle-box and india rubber cylinders, and are firmly bolted to the sole bar by jaws on the upper ends, and kept in their places by diagonal stays at the lower ends. The axle-box is cast with a projecting hollow wing on each side, which is enlarged on the top, to afford a bearing for the bottom of the india rubber cylinder, and leaving a capacious grease-box between them. The upper ends of the india rubber cylinders are received into a cast iron plate, fixed to the sole-bar; and the arrangement of internal coil, or fer-

rules, and external hoops, is the same as previously described, with this exception, that one binding hoop only is used on each cylinder, instead of two, in the case of wagons—rather greater elasticity being required for carriages. Some new passenger carriages, with this description of spring, are now in use on the Monmouthshire Railway.

The present improved form of engine-bearing springs is termed the "hydro-pneumatic springs." The object of this form is to obtain the same amount of elasticity with a less quantity of india rubber, and is accomplished by thinning the cylinder of india rubber internally; and, in the increased space thus obtained, placing a quantity of fluid—water is used for this purpose—which, acting by hydrostatic pressure, distributes the pressure equally over every part of the internal surface; thus obtaining a much larger bearing surface than if the pressure were confined to the ends, and in fact producing precisely the same effect as a solid homogeneous cylinder of india rubber. The fluid does not entirely fill the cavity in the india rubber, at least not when first put in, but is adjusted to do so only on the spring receiving the maximum of impact: the air at the same time, which had before occupied the space left vacant by the fluid, retires into a chamber for that purpose in the upper part of the casting, and being then in a state of considerable condensation, exerts a powerful elastic force, assisting the spring to regain its equilibrium. The air and fluid are prevented from escaping under the ends of the india rubber cylinder, by that part of the casting which receives them being cast with a groove; so that on the application of pressure, the india rubber forces itself into the minutest crevice, and a perfectly tight joint is obtained without the necessity of interposing any other substance.

A spring, on this principle, is applied to wagons, being of very simple construction, and one that requires no alteration of horn-plates or axle-boxes; but which, with very little labor, may be applied to any existing wagon adapted for steel springs.

The same spring is applied to some new engines now being made for this railway. In this case the spring is entirely beneath the foot-plate, in a hollow part of the framing, immediately above the axle guides, by which great compactness is obtained with increased strength of the frame. The internal arrangement is the same as the hydro-pneumatic spring; but the spring piston is cast in one piece with the axle-box; thus avoiding the necessity of using a spring pin, and at the same time dispensing entirely with suspending links, nuts, and bolts—thereby still further reducing the total weight of the spring, which in this case is brought to a minimum.

In constructing buffers, the elasticity of a cylinder of india rubber is combined with that of a colu n of enclosed air. No fluid is used in this case, the position of the buffer and its mode of action not being favorable to its use; neither is it required, as buffers should be sensitive, more so than would be the case were fluid used. Transverse pins, riveted to the external or wrought iron cylinder, serve to confine the fixed and moving part of the buffer, and pass through slots in the plunger to allow them sufficient play. In a cheaper form of this buffer, the external wrought iron case is replaced by a cast iron one, for use where not liable to severe cross strains; the first form referred to being only for extra strong buffers.

Draw springs, for the buffer plank of an engine, and for common wagons, are constructed on the same principle, and only differ in their form and getting up.

The advantages resulting from the use of these springs may be thus enumerated:

1st, Reduction of dead weight. This item is more extensive than appears at first sight, since the reduction of weight is not confined to the springs themselves, but extends, in a greater or less degree, to a variety of other parts of the engine, carriage, or wagon, on account of the smoothness of their action. This is particularly advantageous in the case of cast iron, whose liability to fracture consists, not so much in the weight it has to carry, as its inability to resist strains, jerks, and concussions; these are, however, nearly altogether deadened by the use of these springs; so that a motion uniformly smooth and steady takes the place of one that is very injurious to railway plant, especially to engines; and as the working portions of an engine are made extra strong, with a view to resist the concussions they are subject to with steel springs, it follows that when these are no longer allowed to operate, they may be made lighter without in the least impairing their efficiency. The reduction in the springs themselves is, however, considerable, and the weight thus gained is valuable, particularly in the case of wagons, where it becomes available for tonnage. The amount of this reduction of weight varies, as shown by the following table; but may be taken on an average at from 3½ to 5 cwt. per engine, and the same for wagons.

Comparative Weight of India Rubber and Steel Springs.

Weight of Springs.	India-rubber.	Steel.	Reduction in Weight.
	Cwt.	Cwt.	Cwt.
Engine-Bearing Springs.			
India rubber, 1¼ cwt. . . . . . }	4¼		
Iron Work, 3 cwt. . . . . . }			
Steel Springs taken off, ...		8½	4¼
Engine Hydro-Pneumatic Springs.			
India rubber, 1 cwt, ... }	7		
Iron Work, 6 cwt, , ... }			
Steel Springs taken off, ...		8½	1½
Tender Bearing and Draw Springs.			
India rubber, ¾ cwt, ... }	2¾		
Iron Work, 2 cwt, ... }			
Steel Springs taken off, ...		11	8¼
Carriage Bearing, Drawing, and Buffing Springs, .	4½		
Steel Springs taken off, ...		9¾	5¼
Wagon Bearing, Drawing, and Buffing Springs, .	3½		
Steel Springs taken off, ...		8¾	5¼

2d, Steadiness of motion. This has been referred to before; and it may be added that the great steadiness of the engines with the india rubber springs is the surprise of every one who has witnessed their performance upon the imperfect road on which they are worked.

3d, Durability. Although sufficient time may not have elapsed to test the absolute durability of these springs, yet during the time they have been in use, in consequence of the heaviness of the work, if deterioration had commenced ever so slightly, it would have been observable; but in a large number of the india rubber cylinders that were examined, after being at work for various periods, varying from four to six months, in both engines, carriages, and wagons, in no instance was the slightest alteration visible from the day in which they were first used, nor the slightest permanent contraction in length or expansion in diameter perceptible: it may, therefore, be inferred, that their durability far exceeds anything hitherto applied to the same purpose, and is fully equal to any reasonable expectation or requirement. The specimens shown to the meeting, having been in use for the last five or six months, corroborated this statement. The weight of each pair of the engine springs is from 4½ to 9¼ tons.

4th, Saving in repairs. The simple construction of these springs renders it almost impossible for any injury to happen to them; consequently little or no repairs are needed. As stated before, the cost of repairing the steel springs of fifteen engines, for six months, was 251*l.* 9*s.* 9*d.* The cost of repairing the india rubber springs of fourteen engines, during the last six months, was only 1*l.* 18*s.* The saving in the cost of repairs is not confined to the springs alone, but the engine itself; the carriages and wagons to which they are applied, and even the permanent way, share the advantage. It is found that fewer chairs are broken, fewer rails (plates rather) are bent, less grease and oil are used for the bearings, and the cost of maintaining the wagons is reduced when india rubber is used. It is inferred, with a considerable degree of probability, that, from the absence of any jerk upon the axles, the tendency of the iron to become crystallized or altered in its nature, and suddenly fracturing, so often complained of, and which has produced so many serious accidents upon railways, will, by the use of these springs, be nearly overcome, and the axles remain perfect for a much longer period; more especially as under the india rubber springs they show no tendency to heat.

5th, Cost. The question of first cost does not properly belong to this paper, but it will be sufficient to state that a well constructed india rubber spring ought not, in any case, to exceed the cost of a steel spring of equal strength; but on the hydro-pneumatic principle it will be found to be considerably cheaper, especially for engines, amounting, on an average, to 20 per cent. saving on the old plan.

The foregoing remarks have been made chiefly with reference to bearing springs; but they apply equally to both buffer and draw springs; and in proportion to the extent in which india rubber is used in place of steel, does the improvement in the rolling stock become apparent, and the benefit resulting from its use more strongly develope itself. The pneumatic buffers, it is considered, have been subjected to a peculiarly severe test, few lines of railway in the kingdom possessing such disadvantageous circumstances. Almost every other description of buffer had been tried previously with the same want of success, until, from repeated failures, the attempt to obtain a permanent buffer was almost abandoned in despair, and solid blocks of wood were substituted for them in many in-

stances. With these buffers, however, no failure has taken place, nor in any instance has their elasticity diminished in the slightest degree. In the accompanying table, the deflexion of this description of buffer and the several kinds of springs, under different weights, is shown:

Table of Deflexion of Springs.

Load.	Engine single spring.	Engine triple spring.	Engine hydro-Pneumatic	Wagon spring.	Buffer spring.	Draw spring.
	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.
$\frac{1}{2}$ ton.	5-6	$\frac{1}{4}$	$\frac{5}{8}$	$\frac{7}{8}$	3-16	1
1st ton.	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{7}{8}$	$1\frac{1}{4}$	$\frac{3}{4}$	$1\frac{1}{2}$
2d "	$\frac{5}{8}$	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{5}{8}$	$\frac{5}{8}$	1
3d "	$\frac{5}{8}$	$\frac{5}{8}$	$\frac{1}{8}$	$\frac{1}{2}$	3-16	$\frac{5}{8}$
4th "	$\frac{3}{8}$	$\frac{1}{4}$	1-16	—	$\frac{1}{8}$	—
5th "	$\frac{3}{8}$	$\frac{1}{4}$	1-16	—	3-16	—
6th "	$\frac{3}{8}$	—	—	—	3-16	—

Before the application of india rubber draw springs to the engines and tenders, the couplings were frequently breaking, and also the frame ends; but since their adoption nothing of the kind takes place. Such are the advantages of these springs, that their adoption promises to become general, and it will be shortly, without doubt, as rare to meet with a wagon unprovided with a draw spring, as it was formerly to meet with one.

In working 15,000 miles, the cost of repairs is found to be reduced in the engines using india rubber springs, in corresponding engines of the two classes, from $5\frac{3}{4}d.$ to $3\frac{3}{4}d.$ per mile, and from $7d.$ to $3\frac{1}{4}d.$ per mile.

It has been the writer's object in this paper to state rather what has been done than to speculate on what will be; but it is notorious that the ordinary steel springs are deficient in point of general efficiency, whether as regards elasticity, durability, or cheapness. It may be that competition may cause their manufacture to be less strictly attended to than formerly; or it may be, and most likely is, that the requirements of the present day have outstripped their ability to perform. However, be that as it may, it is well known that a substitute which shall combine the above requisites has been long desired; and the writer's hope, therefore, that this desideratum will now be supplied by the springs which have been described, must be his apology for bringing the subject before the Institution.

Mr. Craig exhibited a set of the different descriptions of india rubber springs described in the paper, and also specimens of the india rubber cylinders, taken out of various springs which had been at work on the Monmouthshire Railway, to show the effects of wear upon them. One cylinder had worked 8650 miles in the bearing spring of an engine; another 14,060 miles in a carriage bearing spring; and an engine buffer spring that had been six months in constant use was shown; all of these appeared uninjured by the work, and not to have suffered any permanent compression.

Mr. H. Wright observed that he had seen these india rubber springs

at work on the Monmouthshire Railway, and they certainly worked very satisfactorily, and were much better adapted to that situation than steel springs. The case of that railway was very peculiar; it was perhaps the worst in the kingdom for destructive action on the springs, from the great inequality and roughness of the road, which was not upon the edge-rail, but the old tramway system, and with very sharp curves; it was, indeed, impossible for steel to stand in the engine springs; but the india rubber springs appeared to stand the work well.

Mr. W. A. Adams said he was acquainted with these india rubber springs, and had witnessed their working on the Monmouthshire line; it was previously impossible to keep steel springs in order, from the violent jerks they were subjected to, and the substitution of india rubber for steel in that case was an important improvement. As to the general application of india rubber springs, there was a special circumstance in favor of their use in locomotive engines, from the confined position and the want of space to fix a properly proportioned laminated steel spring, which might probably be otherwise made to work satisfactorily; but the steel springs generally used in locomotives were so short and stiff, that their elastic action was exceedingly imperfect, and they were consequently ill suited to withstand the violent concussions of a rough road. In the bearing springs of carriages the case was very different; and a long, thin, laminated spring was employed, which had a very easy, elastic action; so that in that case the advantage would be less felt of the substitution of india rubber for steel. In applying the india rubber springs to carriages, it had to be observed that the bearing of the frame would be on four points only, instead of eight—requiring a stronger frame or cross-bars to distribute the strain.

Mr. Allan said he had made some trial of these india rubber bearing springs on engines, and they worked very well; but he found them too elastic, and liable to produce a jumping action; but the springs he had tried were of the kind first described, without provision for checking the rebound of the spring.

The Chairman inquired whether, if such reaction could be removed, the india rubber spring would be considered superior to steel?

Mr. Allan thought that very little friction or resistance would be sufficient to check the reaction; and the india rubber would then certainly make a very good spring.

Mr. Craig observed, that the rebound complained of was quite stopped by the little resistance offered by the small second spring that had been subsequently introduced; but it was now found that the objection was quite removed by the water application in the new compound spring.

Mr. Clift inquired whether any difference was found between winter and summer in the action of the india rubber? whether there was any more oscillation observed in hot than in cold weather? and whether the india rubber was liable to any injury by the heat to which it was liable to be exposed from the boiler or fire-box of the engine?

Mr. Craig replied, that the india rubber was not affected by the temperature, and no effect was found during the last severe winter; also, in two tank engines, one pair of the india rubber springs was exposed to great heat, probably as much as 240°, being very near the fire-box, but

there was no perceptible effect. The material used for the springs was Moulton's prepared india rubber; the raw gum would not stand exposure to heat, and the constant compression and elastic action.

The Chairman inquired what pressure there was upon the india rubber when the springs were at work?

Mr. Craig replied, that the vertical pressure on the end of the india rubber cylinder, in the engine bearing springs, amounted to about 1½ cwt. per square inch; a weight of 4½ tons being supported on a cylinder 9 inches diameter, having a 1¾-inch hole in the centre. In the hydro-pneumatic spring the pressure on the india rubber was about 2 cwt. per square inch; he intended trying the exact pressure of the water with a Bourdon's pressure gauge, but had not been able to complete the experiments in time for the present meeting.

Mr. E. A. Cowper observed, that he understood a considerable trial of india rubber springs had been made on engines upon the London and North-Western Railway, and inquired what kind of spring had been applied there, and what were the results? He had also heard that on the Great Western they used india rubber springs, and now never hung an engine any other way.

Mr. Craig replied, that the springs tried on the London and North-Western were with two or three cylinders of india rubber, similar to the first arrangement described, and they were working very satisfactorily, and, he believed, were preferred to steel springs.

The Chairman inquired the relative cost of india rubber and steel springs?

Mr. Craig said, that the cost of the india rubber springs did not in any case exceed that of steel. Wagon springs were about 3*l.* 18*s.* per set; but engine springs were considerably less expensive than steel, there being so much greater proportionate weight of steel in the ordinary springs. By the introduction of water in the improved springs, the quantity of india rubber to support the same weight was reduced from 20 lbs. to 12 lbs. in each spring, which, at the cost of two shillings per pound, effected a considerable saving in the expense. A considerable saving in respect of grease had also been observed; but not being able to give the exact results, he would make a comparative trial for the purpose of determining that point.

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*Railway Traffic in Great Briain.**

The traffic returns of railways in the United Kingdom amounted for the week ending 28th May to 326,900*l.*, and for the corresponding period of last year to 287,903*l.*, showing an increase of 38,997*l.*, or 13·54 per cent. The gross receipts for the eight railways having their termini in the metropolis amounted for the week ending as above to 154,438*l.*; and for the corresponding week of last year to 137,545*l.*, showing an increase of 16,893*l.*, or 12·3 per cent. The increase on the Eastern Counties Railway amounted to 1094*l.*; on the Great Northern, to 3390*l.*; on the Great Western, to 2316*l.*; on the London and North Western, to

* From Herapath's Journal, No. 730.

1504*l.*; on the London and Blackwall, to 310*l.*; on the London, Brighton, and South Coast, to 5144*l.*; on the London and South Western, to 793*l.*; and on the South Eastern, to 2342*l.*; total, 16,893*l.* The receipts on the other lines in the United Kingdom amounted to 172,462*l.*; and for the corresponding period of 1852, to 150,358*l.*; showing an increase of 22,104*l.* in the receipts of these lines, which, added to the increase on the metropolitan lines of 16,893*l.*, makes the total increase 38,997*l.* over the corresponding week of 1852.

The total increase in the traffic from the 2d January to the 28th May, over the corresponding period of 1852, amounted to 653,805*l.*, or 11·8 per cent.

Description of M. Maus' Plan for forming a Tunnel through the Alps; and of his Excavating Machine for Tunnelling. By Wm. H. V. Sankey.*

In my former communication (p. 670, vol. x.) I stated that I hoped to obtain information from the Chevalier Maus concerning his plan for forming a tunnel through the Alps. Having since been favored by him with full particulars relating to his project, I now send you a statement of the manner in which he proposes to effect the great object he has in view, prefacing my account with a short description of the route he considers it best to adopt, and a few other particulars in connexion with the subject which may be interesting to your readers.

The line of communication selected by M. Maus skirts the southern side of the Mount Cenis, following the valley of the Dora, and passes by the towns of Susa, Oulx, Bardoneche, &c., thence by means of a tunnel under the ridge of the Alps it proceeds to Modana, a town situated in Savoy, on the west of that extensive chain of mountains, by a route only 30 miles in length; while the existing public thoroughfare over the Mont Cenis pass is nearly 40 miles, so that a saving of about 10 miles would be at once effected between Susa and Modana; and the time required to travel between these two places would, in the event of this project being put into execution, be reduced from eight hours (the time which the mail takes to go by the present road) to one hour and a half, a very moderate calculation for the railway—being only at the rate of twenty miles per hour.

Thus the portion of the great Savoy trunk line of railway, projected by M. Maus, would commence, on the Italian side, at the town of Susa, near the confluence of the Dora with the Cenisis, a rapid stream that takes its rise in the Mont Cenis; and would form a continuation of the Turin and Susa railway, now in course of construction; the line would then pass to the right of the village of Gioglione and over the high grounds of Chaumont (where the mountainous character of the country involves the necessity of two tunnels, which are, however, of minor importance, the one being about 3040 yards in length, and the other only 330. A short tunnel will likewise be necessary at the Fort of Exilles, in order to avoid some of the outworks, and farther on another tunnel, which, however, will be only 2230 yards long. We thus arrive

*From the London Builder, June, 1853.

at Salbertrand, situated ten miles from Susa and nearly 1670 feet above its level, which gives for this portion of the line an average ascending gradient of 1 in 31. Beyond this, passing Oulx, Savoulx, Beaulard, and even for some way farther on than Bardoneche, the surface of the country is remarkably uniform, and will not present any difficulty: the length of this section is about eleven miles, and its average rate of inclination 1 in 57. The remaining nine miles is a descending gradient of nearly 1 in 57, likewise. And here the line obtains a passage beneath the Alpine ridge by a tunnel of about eight miles in length, at a depth of 5248 feet, or as nearly as possible a mile below the surface of the pass.

The three principal gradients above mentioned being divided into others, to suit the nature of the ground, the rates of inclination on some portions of the line will be steeper in certain cases than those named, but in no instance will they exceed 1 in 28. Throughout the whole length of the principal tunnel the gradient will be 1 in 53.

M. Maus estimates the cost of the work as follows:—

For forming a heading with a machine invented by him for the purpose,	£180,000
For increasing the size of this heading, so as to form a tunnel in the usual manner through a lias rock, containing scales of mica and grains of quartz, of so compact a nature as not, apparently, to require any facing in masonry,	370,880
	£550,880
For the remaining portions of the line forming approaches north and south of the proposed tunnel, viz:	
Cost of land,	26,019
Earthwork,	181,366
Bridges, culverts, &c., including the several shorter tunnels above alluded to,	468,448
Rails, chain, sleepers, &c.,	171,969
Total,	£1,398,682

Say £1,400,000 altogether in round numbers.

As the projector considered that the great difficulty in the way of carrying out this bold conception would be the amount of time and labor which, according to our present system of conducting such operations, it would necessarily require, he has contrived an excavating machine, for facilitating the labor, and which, at the same time, is calculated to expedite in a very great degree the execution of this and similar works, and from the success which has attended the trials he has already made with it, he states that he has no hesitation in fixing five years as an amply sufficient period for the completion of the projected tunnels, working at both ends at the same time, although without shafts, which the height above renders impossible.

The excavating machine consists of a frame, in which are set a number of very broad chisels, having projections on their face, acting somewhat after the manner of the hammer used by masons to restore the rough surface to the granite pavement in London when worn smooth by the traffic.

The chisels are so arranged as to cut into the face of the rock, at the extremity of the heading, five horizontal grooves, and two vertical channels bounding the former, and at right angles thereto. These grooves

or channels are run one into the other, and serve to insulate four rectangular blocks of stone, which will then remain attached only by one of their planes to the solid mass of the mountain rock, from which they may readily be separated by wedges, driven with heavy hammers into the grooves.

These blocks will be about seven feet long, three feet wide, and eighteen inches in thickness.

The machine acts only upon half the width of the heading at a time, so that while it is at work cutting the grooves, which separate the blocks of stone at one side, the workmen are engaged in removing those already cut in the other half-width of the heading.

When the machine and the laborers have each completed their tasks, they mutually change places. The machine again sets to work to shape out new blocks of stone, and the workmen proceed to detach those which have just been cut, beginning by inserting the wedges at the top of the heading, and proceeding downwards; by thus prizing the stones, they are easily separated from the rock, after which they are placed on trucks, and conveyed to their destination, so that the space is again left clear for the machine to recommence its operations.

The excavating machine cuts the channels in the rock, by means of several series of chisels placed one beside the other, in straight lines; these lines of cutting tools are so arranged as to be capable of a slight lateral motion in the direction of the grooves after every stroke; the object of this is to bring the chisels to bear upon all the spaces lying between the several cutting tools situate in the same line, so as to produce not a succession of holes, but a continuous channel similar to a very wide saw cut.

This lateral shifting of the lines of chisels, which takes place alternately from right to left, and from left to right, is caused by a corresponding motion given to the frames in which they are fixed. Each chisel is driven against the rock by a spiral string coiled round it, and which produces an effect similar to that caused by the muscles of a man in the act of throwing a javelin. This spring, driving the chisel forcibly against the rock, obliges it to act efficaciously, notwithstanding the slight inequalities at the bottom of the channel, arising from a want of uniformity in the resistance of the stone.

When the machine is in operation, the several lines of chisels are all drawn back simultaneously, by means of a species of cam, or movable bar, which acts against projections formed on the cutting instruments. This, by forcing back the chisels, and thus compressing the above mentioned springs, leaves them in a position to exert a strong percussive force as soon as the pressure is removed. This is effected by suddenly raising the bars, by means of an inclined plane, situated at the proper place for the end of the stroke. As soon as the blow has been struck, the springs are again immediately compressed, as before, and the process is continued until grooves have been worked to the requisite depth into the solid substance of the rock.

Although all the chisels in each row are similarly acted upon by the movable bar, they are, nevertheless, completely independent one of the other, so that they may each be removed at pleasure, without interfering

with the motion of those adjacent, or even suspending the operations of the machine; and if it be observed that one or other does not act efficiently, such may be removed, and new chisels substituted in their stead, without causing any delay or cessation.

The back and forward motion of the bar, which performs the functions of a cam, by pushing against the projections with which the several chisels are furnished, is caused, through the intermediation of rods and cranks, by two rotary drums, which themselves are made to turn by an endless rope, communicating with a water wheel, or other suitable motive power, situated at the entrance to the heading. The apparatus is arranged so as to enable the chisels to strike 150 blows in a minute.

The machine, at the same time, sets in motion a pump, which forces a constant supply of water into a reservoir, the upper part of which is filled with compressed air. By this means, the water is driven out in jets, through small pipes placed between the chisels, and is thus made to play upon the grooves, where it performs the double office of preventing the cutting instruments from getting heated, and removing the dust and chips of broken stone, which would otherwise accumulate in the grooves, and thereby prevent the effective working of the excavator.

The idea that suggested this substitute for manual labor in one of the most tedious of engineering operations is extremely ingenious, and the inventor of this piece of mechanism, which in my opinion is destined, in a short time, to become of general utility, is deserving of the highest credit. I must frankly own that I was not sanguine of its success previous to having examined it; but since I have heard it described, and seen how it works, I feel no hesitation in saying that it will, ere long, be applied to facilitate mining and quarrying operations, and will become extensively used in the carrying out of railway and other works.

I have no motive in extolling thus highly this invention, further than a desire to see introduced and tried on a large scale a mechanical contrivance which recommends itself on account of its extreme simplicity, and very especially because it may be considered the forerunner of a class of automaton laborers which cannot fail to benefit society, inasmuch as they inevitably tend to diminish human toil, and thereby will have the effect of raising the working man in the social scale, and enabling him to find leisure to cultivate his mental faculties; while, at the same time, it will afford increased encouragement to the progress of industry, and will enable us to undertake and prosecute successfully many splendid and important engineering projects which, without its aid, we should not even have dreamed of.

The manner in which the engineer proposes to provide for a proper supply of fresh air during the progress of the work is by means of a tubular ventilator, which he intends to lay along the bottom of the gallery. At given intervals throughout its entire length, according as they may be found necessary, he would insert fans, which he suggests might be placed on the spindles or shafts of the rollers or sheaves over which the endless rope is made to pass, so that they could constantly be worked with very little additional expense. These fans would force the air from one chamber of the tube into that immediately succeeding it, and as the ventilator would be made air-tight throughout its whole length, and

only open at its extreme ends, so that the air introduced through the tube may pass out through the heading, he considers that a constant current of pure air would thus be continually maintained in the tunnel, which, by its uninterrupted circulation, would cause incessant, successive, displacements as to prevent any possible accumulation of noxious gases or unoxygenated atmosphere.

Since writing the above, I have learned that Mr. Robert Stephenson, the eminent English engineer, when passing through Turin, on his way to Egypt, in the month of September, 1850, went to see the experimental machine then in operation at Valdoc, and M. Maus says he recalls with much pleasure the approbation and encouragement given him by our distinguished fellow-countryman, who, in a letter addressed to the Sardinian Minister for Public Works, stated it as his opinion that it would be advisable for the Government to make a trial of the excavating machine on an extensive scale.

The exhausted state of the Piedmontese exchequer, consequent upon the war with Austria, and the expenses of the great works connected with the line of railway between Genoa and Turin, have hitherto precluded the possibility of putting the invention to the test of practice in the actual execution of the works proposed. Nevertheless, now that the question of forming lines of railway through the Alps is every day becoming of greater importance, the time is probably not far distant when we shall see active measures taken for the realization of this important proposition.

AMERICAN PATENTS.

List of American Patents which issued from August 16, to September 6, 1853, (inclusive,) with Exemplifications by Charles M. Keller, *late Chief Examiner of Patents in the U. S. Patent Office.*

AUGUST 16.

38. For an *Improvement in Bedstead Fastenings;* George W. Baynes, Thomas Hinty, and Minter Jackson, Glenville, Virginia.

"The nature of our invention consists in so constructing a bedstead, that one of the tenons being pivoted or swung in a mortise in the rail, free to rise and fall in the mortise of the post, while the other tenon is rigid in its connexion with the rail, may, by means of screws operating on the head and foot rails, securely fasten, not only these rails, but the side ones also, by the same device."

Claim.—"Having thus described the nature of our improved mode of fastening bedsteads, what we claim is, the combination and arrangement of the tenons, *a a*, tenons *d* and *f*, with the screw, B, for the purposes set forth."

39. For an *Improvement in Meat Tenderers;* William Beach, Philadelphia, Penna.

Claim.—"What I claim is, forming a meat maul, for the purpose designed, by securing to one end of an oblong block of wood, whose opposite end is formed into a handle, a series of rows of tapered teeth of the form described, cast on a plate, or driven singly into the wood, as may be desired."

40. For an *Improvement in Hinges for Folding Bedsteads;* John Binder, Chelsea, Massachusetts.

Claim.—"What I claim is, the method described, of constructing a hinge with the circular bearing surfaces, for the purpose set forth."

41. For an *Improvement in Gun Locks;* P. F. Charpie, Mount Vernon, Ohio.

"The nature of my invention consists in connecting the dog of a main spring to the hammer, by means of a screw passing through a curved slot in the lock plate, in combination with suitable packing encompassing the slot on the outside of the plate; by this combination I am enabled to use an extremely simple and useful device for a gun lock, and to place the principal parts on the inside of the plate, fully protected from moisture."

Claim.—"I do not claim the arrangement of the hammer, main spring, and dog, as shown, for that has been previously used, and placed on the outside of the lock plate; but what I do claim is, conducting the dog to the hammer by means of a screw passing through a curved slot in the plate, in combination with the packing which encompasses the curved slot; by which combination I am enabled to place the main spring and dog on the inside of the lock plate, and prevent the admission of moisture within the lock, as set forth."

42. For an *Improvement in Printed Carpets;* Thomas Crossley, Roxbury, Mass.

Claim.—"I am aware that carpets and woolen fabrics of various descriptions have been stamped and printed upon one side, the other invariably being disfigured by the operation; and also, that two and three ply carpets have been printed with the same or different figures upon the two sides, as I have myself received a patent for a carpet so produced, as before stated: I therefore now lay claim to none of these processes; neither is it my intention at present to found any claim upon the method in which I weave my carpet; but what I do claim is, a single ply printed carpet, made by combining the warps and filling in the manner described, and subsequently printing them on one or both sides; I having discovered that fabrics woven in this manner could be printed on one or both sides without the colors passing through, and discoloring or intermingling with the colors on the opposite side of the fabric."

43. For an *Improved Rudder Brace;* Benjamin F. Delano, Chelsea, Massachusetts.

"The nature of my invention consists in the application to the rudder head of a lever or brace, which is permitted to turn freely upon a pintle or centre, projecting from the deck of the vessel, which lever is suitably connected to the rudder head by arms with flexible or hinge joints, by which means the rudder stock is caused to turn freely in the opening in the deck through which it passes, which opening may then be made sufficiently large for the purpose, and thus the friction, straining, and noise, are avoided, and the rudder receives an additional support, rendering it more secure and safe in its position."

Claim.—"Having thus fully described my invention, what I claim is, 1st, The brace, connected with the rudder, substantially as described, and operating in the manner set forth. 2d, The combination of the brace with the elliptical tiller, or any other analogous device, for the purpose of actuating the rudder by the application of power to the braces, instead of to the rudder itself."

44. For an *Improvement in Facing Buildings;* Michael B. Dyott, Philadelphia, Penn.

"The nature of my invention consists in an improved mode of uniting, fastening, and supporting cast iron or other plates to the external walls of buildings, whereby the said plates form an ornamental facing thereto, are protected against external injury, and secured from the injurious and disfiguring effects of moisture from the interior."

Claim.—"I do not claim the facing or securing of stone to the surface of buildings in any manner, or by any means whatever, nor embedding any other substance in mortar or cement upon the surface of walls; neither do I claim the facing of brick walls with iron or other plates, by building them in mortar with the wall, and fastening them by bolts or ties, as I am aware that these things have before been done; but what I do claim is, the method herein described, of supporting a veneering or facing of thin cast iron, or other plates, upon their inside, and uniting the same firmly with the external surface of the building, by so fixing the plates in relation to the wall as to leave a sufficient space between them to allow a cement in a liquid form to be poured in to fill the space and all the interstices of the plate, perfectly solidify around and upon the hooks and other fastenings, exclude the air and all dampness, whereby the veneering is strengthened, protected, and preserved, as fully set forth."

45. For an *Improvement in Machines for Preparing Spoke Timber;* Aaron W. Geaheart, Beallsville, Ohio.

"The nature of my invention consists in so constructing the clamping and guiding or gauging portions of a machine, placed on a seat board, that great exactness may be ob-

tained in getting out spoke timber with the ordinary drawing knife, whereby I effect the saving of three-fourths the labor of the ordinary method heretofore used."

Claim.—"What I claim is, the arrangement of the adjustable bed, the bridle or clamp, the sliding guide or gauge, and foot lever, for the purpose and operating in the manner substantially set forth."

46. For an *Improved Socket for Auger Handles and Braces;* Arshal H. McKinley, Higginsport, Ohio.

"The object of my invention is to provide a convenient device for readily shipping and unshipping an auger, or other boring tool, to and from its handle, so that one handle may serve a great number and variety of tools, and thus save a great deal of room in the tool chest."

Claim.—"I do not claim the enabling the shipping or unshipping of a bit or auger from its stock or handle, that having long been accomplished; but what I do claim is, the peculiar arrangement of mechanism by which I enable the shipping and unshipping of the bit and handle of an auger, or other boring tool; that is to say, the socket having a circular head and vibrating cap whose aperture can be made at one position to coincide with the mouth of the socket, and in the other position to oppose its straight edges to the projecting corners of the shank, the cap being retained in the desired position by a spring and notch, as described, or its equivalents."

47. For an *Improvement in Draft Apparatus of Seed Planters;* Jacob Mumma, Mount Joy, Pennsylvania.

"My improvement in seed drills consists in combining a pole (for the horses) with a supporting and directing wheel, so as to relieve the horses from the strain they incur in other drills, and also to be enabled to run the drill straight forward, or keep it in its course, even if the horses deviate considerably."

Claim.—"What I claim is, the combination of a tongue having motion vertically and laterally with the directing and supporting wheel, substantially as set forth."

48. For an *Improvement in Drop Hammers;* E. K. Root, Hartford, Connecticut.

Claim.—"I do not wish to limit myself to the special construction herein specified, so long as the same effects are produced by equivalent means; what I do claim is, the method of elevating the drops or hammers by means of a screw having a continuous rotary motion, in combination with the mechanism, or its equivalents, for disconnecting the drops or hammers from the screw, to permit them to drop, substantially as described. I also claim the method of disconnecting the drops or hammers, by the rotation of the elevating screw, which is notched to catch and act upon the finger, or its equivalent, connected with the side, or its equivalent, to force it back and clear the thread of the screw, substantially as specified. I also claim, in combination with the slide which connects the drop or hammer with the elevating screw, and with the finger on the slide, or their equivalents, the employment of a catch lever, or its equivalent, holding up the drop or hammer when it is liberated from the elevating screw, and there to hold it until it is required to be dropped, substantially in the manner described. And, finally, I claim, in combination with the slide which forms the connexion with the elevating screw, and with the catch that holds the said slide when liberated from the elevating screw, or their equivalents, the employment of the rebound latch, or its equivalent, which liberates the parts by the rebound, when the drop or hammer strikes, substantially as specified."

49. For an *Improved Trip Hammer;* William Van Anden, Poughkeepsie, N. Y.

Claim.—"I do not claim elevating the hammer shaft by means of cams; neither do I claim the friction rollers, irrespective of the particular manner of arranging or attaching them to the hammer shaft, as herein shown; but what I do claim is, 1st, Attaching a collar to one end of the hammer shaft, said collar working loosely over a shaft which has a spring attached to it, for the purpose of forcing down the hammer shaft. The shaft being provided with a set screw, or its equivalent, and lever, arranged as described, by which, upon properly adjusting said set screw, or its equivalent, the hammer may be made to descend upon the block or anvil with greater or less force, as desired. 2d, I claim the employment or use of the friction rollers attached to a vibrating frame, and arranged substantially in the manner as herein shown, for the purpose of relieving, instantaneously, the cams from the pressure of the rollers, when the highest points of the cams have passed the lowest centres of the rollers, thus preventing the wearing of the cams at their highest points, as set forth."

50. For an *Improvement in Breech Loading Fire Arms;* John P. Schenkl, Assignor to John P. Schenkl and Adolph S. Saroni, Boston, Massachusetts.

"My invention consists in a method of unscrewing the breech from the barrel, and withdrawing the same, of turning up the breech so as to bring its chamber into a vertical position for loading, and then returning the breech into the barrel, and locking the two together, which motions are performed through the intervention of appropriate cams, catches, and springs, by the motion of a single lever worked by the hand of the gunner."

Claim.—"I do not claim uniting the breech to the barrel by means of male and female screws, portions of which are cut away to enable the one to enter the other, the two being secured together by a partial revolution of one of them, as this has been done before; but what I do claim is, the above described combination of parts, for the purpose of operating the movable breech, constructed and arranged substantially as described."

51. For an *Improvement in Hill Side Ploughs;* William Harrison Bablitt, Waynesburgh, Pennsylvania.

Claim.—"Constructing and arranging a head in the hinge which connects the beam of the plough with the upright, so as to lock said hinge by means of a bolt before the pivot of said hinge, and by a lever behind said pivot, for the purpose of making the bearings in said hinge adjustable, substantially as set forth."

52. For an *Improved Screw Wrench;* Aury G. Coes, Worcester, Massachusetts.

Claim.—"I am aware that the movable jaw of a wrench has been made to slide on a shank, by means of a female screw nut placed on a screw cut on the shank, the said nut being so connected with the movable jaw as to be capable of being put in rotation, and of moving the jaw on the shank. I am also aware that the movable jaw has been moved by means of a screw; I therefore do not claim such to be my invention. But what I do claim is, the combination and arrangement of the screw tube, its male and female, or external and internal screws, the screw on the shank, the annulus, and its female screw, as applied to the sliding jaw; the whole being made to operate together, substantially in manner and for the purpose of enabling a person to readily move the sliding jaw on the shank with a velocity compounded of the velocities of motion of two female screws on two male screws, as described."

53. For an *Improved Ships' Block;* William Coleman and Stephen G. Coleman, Providence, Rhode Island.

Claim.—"We claim as our invention, the above described mode of constructing the hook and eye staple of the ship's block, and supporting it within, and by means of the checks, without any extension of it around and in contact with the sheave pin, and whether each of the checks is made whole or in two parts, as herein before specified; and in combination therewith, we claim the mode of sustaining the sheave pin and connecting the two parts of each cheek, viz.: by a metallic rod extending through them, and directly under and against the sheave pin, substantially as specified."

54. For an *Improvement in Machines for Pegging Boots and Shoes;* Alpheus C. Gallahue, Alleghany City, Pennsylvania; ante-dated February 18, 1853.

"The nature of my invention consists in so constructing a machine that the punching of holes, cutting pegs, and driving them by percussion (not forcing) into the soles of boots or shoes, is performed at one operation; and that, instead of moving the machine over and around the work, which is attended with great complexity of machinery and expense, I am enabled to move my work under the operative portions of the machine, and by simplifying the mechanism, greatly reduce the cost, and render practical the operation as applied to all sizes and shapes of the sole, without any change being necessary, except that of substituting one of the ordinary lasts for another."

Claim.—"Having described my improvement, what I claim is, 1st, The sliding lever, (having a hook thereon for entering the staple of the last,) which, passing through slots in the uprights of the turn table, secures the last to said table, by the introduction of the wedge, as set forth. 2d, I claim the turn table, mounted on the sliding table, which works on ways upon the moving table, and is actuated by springs for the purpose of keeping the edge of the sole in contact with the gauge, when this is combined with mechanism for giving the turn table a semi-revolution at the point where its centre is brought opposite the awl by the motion of the table, that regularity in inserting the pegs may be secured. 3d, I claim the combination of the spring, lever 16, catch, or their equivalent, sliding wheels, racks, and mitre wheels, by which a semi-revolution is given the turn table (while

the pegs are being inserted around the heel,) by the slipping of a cog wheel from rack 7 to 6, on the release of lever 16 from catch 3 *s*, and the return of said cog wheel into rack 7, on the release of spring *n* from catch *l*, by which means it acts on the upper side of lever 16, as set forth. 4th, I claim the cam, 53, rod, 52, secured to hammer *x*, and helical spring, *f'*, by which a graduated driving stroke is given the awl and its rod, in combination with cam 2, rod *h*, (upon which slide the hammer,) and helical spring *g'*, by which a driving stroke is given the peg driver alternately with that of the awl and its rod; it being understood that I do not claim the general feature of a hammer and rod carrying an awl, and spring for driving the awl, operated by a cam, as this has been done heretofore; but the particular mode or combination in which they are used as here claimed. 5th, I claim giving the peg tube and driver a side motion, independent of the awl and awl rod, by means of cam *o*, and lever *a*, or their equivalent, for the purpose of bringing the peg directly over the hole punched in the sole of the shoe by the withdrawn awl; the whole constructed and operating substantially as set forth. 6th, I claim the combination of cam *o*, and stirrup *m*, with the swung peg cutter, by which the peg wood is split with the grain of the wood from below, by the knife at 55, and at the same time forced in the tube in *n*; it being understood that I do not claim the general feature of a peg cutter forming one side of the tube through which the peg is driven, but only the particular mode of applying it, as here claimed."

55. For an *Improvement in the Oven Doors for Cooking Stoves and Ranges;* Gibson North, Philadelphia, Pennsylvania.

Claim.—"I do not claim the application of brick, or any other material which is retained in its place by lattice work, or some other similar contrivance; but what I claim is, the application of an adhesive coat of enamel, or other substance answering the same purpose, to the inside of the oven doors of ranges or cooking stoves, substantially as described."

56. For an *Improved Boat or Scow;* Abijah R. Tewksbury, Boston, Massachusetts.

Claim.—"I claim the above described improved method of constructing a boat, viz: by attaching its sides and ends to its bottom by water tight hinges, in combination with connecting the edges of the sides and ends by water tight flexible gores, substantially as described, and so that the boat may be unfolded on the sides, and ends be turned down into the plane of the bottom thereof, as hereinbefore explained."

57. For an *Improvement in Discharging Breech Loading Fire Arms;* Henry Stanton, U. S. Army.

"My invention relates to that class of fire arms and ordnance which is loaded at the breech instead of the muzzle, and consists in constructing a movable breech in such manner that it will, when placed in one position, form a prolongation of the bore to allow the load to be introduced through it into the chamber of the piece, and when placed in another position, will close the butt end of the bore, preparatory to firing off the charge; and, in addition to these, which are the ordinary duties of this class of breeches, this shall also perform the duty of a lock, in firing the charge."

Claim.—"What I claim is, the method herein described, of firing the charge of breech loading arms by the breech itself, in the act of closing, thereby dispensing with the ordinary lock, and greatly simplifying the construction of arms, and diminishing, correspondingly, their cost and liability to get out of order, and increasing their durability and efficiency. I also claim the method of igniting the charge by shearing through the fulminating compound attached to the cartridge, substantially as herein set forth."

AUGUST 23.

58. For *an Improvement in Processes for Purifying Alcohol;* Luther Atwood, Boston, Massachusetts.

"The nature of my invention consists in destroying, by chemical means, the fusel oil and odorous oils found present in alcohol and alcoholic spirits. I take of finely ground manganese oxide, 3 lbs., nitrate of potash, or nitrate of soda, 5 lbs., in a state of mixture, and slowly melt them in a crucible, continuing the heat until the melted mass passes from a fluid to a stiff pasty mass. When cold, the mass must be powdered and kept dry for future use. It contains manganate of potash or soda, or gives permanganates of these bases, with excess of potash or soda and earthy impurities. For every gallon of alcohol of 85 or 90 per cent., I use two ounces of the manganic compound, dissolved in 8 oz. of water, and add the solution to the alcohol while the whole is briskly agitated. This proportion is the average quantity required for common alcohol, but so much should be used

as is sufficient to destroy the odor of the fusel oil; and the purified alcohol must then be distilled from the matters dissolved and suspended in it by gentle heat."

Claim.—"What I claim is, the use of the manganates and permanganates, existing as soluble compounds, however obtained, for purifying alcohol, so as to adapt it to nice purposes."

59. For an *Improved Method of Generating Steam;* Jean Baptiste Moinier and Pierre Hippolite Boutigny, Paris, France; patented in France, January 18, 1853.

"The nature of our invention consists in so forming the generator as to cause a direct production of steam at high temperatures, (500 degrees and upwards,) by means of injecting water at the top, or near the top of the generator, when the same is in a heated state, and causing the water to come in small quantities in contact with the surfaces of perforated metallic diaphragms, (placed within the generator,) and also to come in contact with the sides of the generator, so as to increase the evaporating surface of the generator."

Claim.—"What we claim as our invention in generators for generating steam at high temperatures from water introduced into the generator, when in a highly heated state, is, injecting or introducing water from the top, or near the top of the generator, when this mode of feeding or introducing the water is combined with the series of perforated metallic diaphragms described, arranged one above another in the generator, so as to subdivide the water, and at the same time increase the evaporating surface of the generator, substantially as described, the water being gradually heated, and subdivided in its passage through the apertures or meshes of the diaphragms, before it comes in contact with the more highly heated surface of the generator, substantially as described."

60. For an *Improvement in Soap Cutting Machines;* James B Duff, City of N. York.

"The nature of my invention consists in the employment of a traversing slatted bed or carriage, having a hinged head piece or follower, in combination with a series of vertical and horizontal yielding wire cutters."

Claim.—"What I claim is, making the wire knives, arranged and set with weights, capable of yielding, so that they will form a loop in passing through the soap, and consequently cut it smooth and straight, in combination with the feeding slatted bed, or any other equivalent device for feeding and forcing the soap up to the said yielding wire knives, the whole being constructed and arranged, and operating essentially as herein described."

61. For an *Improvement in Oscillating Steam Engines;* Morris J. Gardner, York, Pa.

"The nature of my invention consists in the manner of introducing the steam through circular tubes into the steam chest, and at the same time constituting these tubes the circle around which the cylinder oscillates, in the manner substantially set forth."

Claim.—"What I claim is, the mode of introducing the steam; the circular steam tubes, the circular steam chest, and packing boxes, operating in the manner herein described. I do not, however, confine my claim to the precise position or dimensions of the various parts described in the foregoing specifications, but to use such positions and dimensions substantially the same, as may be best adapted to produce the desired effect."

62. For an *Improvement in Seed Planters;* Peter Horn, Hagerstown, Maryland.

"The nature of my invention consists in providing the boot with an arm, which is attached to the frame by a hinge, and is operated by a lever whose fulcrum is also attached to the frame, and by which the boot may be lowered or elevated at pleasure; also, in having the feed bar divided in the centre, and each operated by different powers."

Claim.—"What I claim is, the spring, in combination with the projection, and arm or lever, for the purpose of opening and closing the recess through which the seed passes, substantially as set forth. 2d, I claim the arm or lever, in combination with the lever and fulcrum, for the purpose of raising or lowering the drill tubes, and operating the springs, substantially as set forth and described."

63. For an *Improvement in Hay Rakes;* Frederick B. Parker, Queensville, Indiana.

"The object of my invention is, to provide an efficient preventive to the accidental tipping of the rake."

Claim.—"I claim as new, the spring catches, projecting downwards from the front ends of the hand bars, and provided with sloping lips, which, bearing upon the front tines, assist in holding the rake to its place until relieved by the withdrawal of the main stop, in the manner described."

64. For an *Improvement in the Arrangement of Cutters for Turning;* Milton Roberts, South Levant, Maine.

"This invention relates to an improved lathe attachment for turning bedstead posts, chair stuff, and the like, and consists in placing a series of knives or cutters and beading tools, one or both being used, in a suitable frame; said frame being moved in a direction transversely of the stick to be turned. The stick is centred in an ordinary lathe, and the frame, with its guides, are so attached to the lathe as to allow the knives to come in contact with the stick as the frame is moved; the knives operating upon the stick sufficiently to give it the required form during a single stroke or vibration of the frame."

Claim.—"Having thus described the nature and operation of my invention, what I claim is, arranging straight edged and grooved cutters on a frame moving parallel to the axis of the lathe, when said cutters are placed in pairs obliquely to the piece to be turned, each set forming salient angles with each other in the frame, by which arrangement each set acts by a gradual drawing cut upon the piece, the grooved tools following to finish the work."

65. For an *Improvement in Grate Bars;* Samuel Vansyckel, Little York, New Jersey.

"The nature of my invention consists in casting or otherwise securing to the under sides of grate bars, hooks or catches, through which series of hooks or catches a rod or bar is passed and held, and by which the grate bars are prevented from warping or twisting by the heat, or from falling down, if one end should slip off."

Claim.—"Having thus fully described the nature of my invention, what I claim is, forming a hook or catch upon the under side of the grate bars, and passing through or over said hooks or catches a holding bar to prevent twisting or warping, substantially as described."

66. For an *Improvement in Butter Workers;* Lettie A. Smith, Pineville, Pa.

"My invention consists, 1st, in combining with a butter tray or pan, a cooling drawer or reservoir, which is placed under it, and into which ice is placed for keeping the butter in a cool and nice state while being worked. 2d, In an adjustable apparatus for working the butter, one end of the handle of the same passing through a circular opening in the back of the stationary frame, and the other end extending over the front part of the tray."

Claim.—"What I claim is, 1st, the combination of the cooling drawer or ice box, with a butter tray, for the purpose described. I do not claim, in general, the device of the working lever, in combination with a butter tray or table; but I claim forming such working lever with acute angles at the sides of its working face, so that it may serve the double purpose of breaking or pressing the butter, and turning it over."

67. For an *Improvement in Railroad Car Seats;* William M. Warren, Watertown, Connecticut.

"My invention consists in the employment or use of sliding foot boards, constructed and arranged in a peculiar manner, so as to be used on either side of the seat, as occasion may require."

Claim.—"Having thus described my invention, what I claim is, the manner in which the foot boards are constructed and arranged, viz: the foot boards being attached by joints to slides, said slides having racks on their upper surfaces, and working on beds connected by hinges; the under sides of the slides being provided with spurs or clicks, which catch into the racks, and retain the foot boards when pressed upon by the feet; the beds being retained underneath the seat when the foot boards are not in use, by means of the catches, or by any other convenient mode."

68. For an *Improvement in Boring Cannon;* Louis A. B. Walbach, deceased, late of the United States Army.

"1st, My invention consists in producing a cylindrical hole in any solid substance suitable for making cannon or small arms, by boring out an annulus of the diameter of the required hole, leaving a central core, two-thirds, more or less, of the diameter of the bore, which can be broken off when the annulus is completed to the required depth, and removed in a solid mass, instead of being cut into fine chips or shavings, as in the ordinary way of boring, whereby much labor and time are saved, and the expense of boring is greatly reduced. 2d, The core likewise furnishes a sample or test of the nature or quality of the material in the interior of the substance being bored, and this method of sampling the material, which is highly important in the boring of cannon, constitutes another branch of my invention. 3d, The means of removing the core after the annulus is bored, consti-

tates another branch of my invention." "This mode of boring cannon differs from all others now practised or known; 1st, In leaving a solid core formed by the cutting of an annular space around it while the boring progresses, and which core is usually of greater bulk than half of the material to be removed; and, 2d, In afterwards detaching this core as a solid, instead of reducing it to particles in the form of chips and dust, as in the usual mode of boring. The dead centre of the ordinary boring tools, which is a great impediment to the progress of the work, is entirely avoided by my method of circumaxial boring, wherein no such centre exists. The centre of every common boring bit forms its pivot or axis of revolution, and having little or no circumferential motion, cannot possibly cut out a chip. It can therefore only progress through the substance by the force of pressure or crushing alone. In my method, the cutting edge is reduced in extent to at least one-third of that of any other boring tool, by which both time and expense are saved, in proportion to the diminished amount of material to be removed; and being placed at and near the periphery of a hollow cylinder, it works there with greater effect in the ratio of its greater distance from the axis, and by avoiding the dead centre of other modes of boring, effects a still further saving of time, in proportion to the greater facility of cutting, over that of forcing or crushing a tool into the mass to be perforated."

Claim.—"What I claim is, the method herein described, of boring cannon, or the barrels of other ordnance or fire arms, by perforating the same with an annular hole, which leaves a central core, in combination with a second operation for detaching and removing the core, substantially as specified, whereby the amount of material to be reduced to chips, the time and labor of boring, and the wear of tools, are greatly diminished, and the accuracy of the work increased. I also claim the transverse cutter, or the equivalent thereof, for grooving or cutting off the base of the core, substantially as specified. I likewise claim the method herein described, of ascertaining the quality of the gun by taking out a core of sufficient diameter and length from the axis or centre of the bore, to be tested mechanically, or otherwise."

69. For an *Improvement in Counterpanes;* Zacharia Allen, Providence, Rhode Island.

"It has long been an acknowledged desideratum to produce a woven cotton counterpane, as ornamental and durable as the Marseilles quilt or counterpane, and at little or any greater price than a common calico sheet of the same size, weight, and quality of material, so that while it would be sufficiently neat and ornamental to adapt it to the tastes and use of the rich, its price will be so low as to bring it within the reach of all who can afford to maintain a bed. The object of my present invention is to supply this desideratum, and it consists in weaving cloth of a width equal to the length required for a counterpane, the weft of the cloth being composed of cord and thread woven in alternate order, the thread being the usual size for the warp employed, and the cord considerably thicker; the different wefts being so woven as to form a ribbed surface."

Claim.—"What I claim is, the ribbed counterpane herein described, as a new manufacture, it being so made that the thickness and twist of the cords forming the ribs on the same, by their tendency to untwist, will give to the said ribs a wavy or undulating surface, as herein set forth."

70. For an *Improved Padlock;* Henry Ritchie, Assignor to Samuel C. Thompson, Geo. W. Westerfield, and Henry Ritchie, Newark, New Jersey.

"This invention relates to a new and useful improvement in spring padlocks, and consists in the combination of a bolt, toothed tumbler, and guard, so arranged as to prevent the bolt from being forced from the shackle in the bow by means of blows, or by violently striking the case of the lock; the toothed tumbler also allowing the lower end of the bow, when pressed in the lock, to operate the guard, and thus allow the bolt, or its projection, to pass into the shackle."

Claim.—"Having thus described my invention, what I claim is, the combination of the bolt, guard, and the double toothed tumbler; one tooth of said tumbler fitting in the shackle, and the other tooth fitting in the notch at the back of the bolt; the bolt, guard, and tumbler, operating as set forth in the body of the specification."

71. For an *Improved Machine for Cutting and Beveling Printers' Rules;* Snow Magoun, Newton, Assignor to Emery N. Moore and Charles H. Crosby, Boston, Mass.

"Printers' rules, the strips of metal used by printers for ruling lines, have hitherto been cut off and beveled by a slow and tedious process by hand, the strips being usually cut off by a saw, and the edges afterwards mitred or beveled by filing. By my improved machine they can be finished with much greater speed and nicety than by hand, being cut off and beveled by a tool set in a sliding carriage, and operated as explained."

Claim.—"What I claim is, the machine herein above described, for cutting and beveling printers' rules, constructed with a sliding tool carriage, which carries the cutting tool forward and back across the rule, as above set forth."

72. For an *Improvement in Diving Bells;* Johnathan Foreman, Boston, Massachusetts, Administrator of Edgar W. Foreman, deceased, late of New Rochelle, New York, and Assignor to Henry W. Sears, City of New York.

"The nature of this invention consists in so combining with a reservoir of condensed or compressed air at the surface, and in connexion with the driving chamber, an arrangement of sliding blocks or movable pulleys attached to an anchor and the diving chamber, that motion and direction may be given to the diving chamber. The peculiarity of this invention is, that by the combination of a reservoir of condensed air at the surface, in communication with the diving chamber and the traversing block, it is practicable at all times so to regulate the equilibrium of internal and external pressure, and to control the movements of the bell. 1st, Exceedingly light and weak materials may be used in construction; 2d, That the specific gravity of the diving chamber, through the medium of the compressed air as a motor, may be instantaneously changed, and either ascent or descent may be attained solely at the will of the operator within said chamber. The condensed air acting instantaneously, causes an expulsion of a certain desired amount of water. A correspondent buoyancy is thus effected, which may be absorbed by a weight, say a stone to be transported to a certain designated spot. The power from the reservoir thus gives vertical movement to the machine and mass to be operated on, which upward motion may be checked at any moment by properly working the air and water valves. The mass thus held in suspension is now moved by the arrangement of anchors and cables passing over the movable pulleys, as described, the point of traction of the cables being regulated by the movable block. The desired spot being reached, by allowing the admission of water, the mass, or the machine itself, will descend to the bottom, but not occupy the precisely desired spot; by successive action of the air valve, vertical, and at the same time horizontal, movements may be effected until the machine or suspended mass occupies the indicated spot."

Claim.—"What is claimed is, the combination of the reservoir of compressed air at the surface, in connexion with the diving chamber or bell, and the arrangement of the movable block or pulley, as herein described, whereby the chamber or bell may be moved and directed at the will of the operator within, for the purpose above set forth."

73. For an (*additional*) *Improvement in Machines for Separating Straw from Grain;* Elisha S. Snyder, Charlestown, Virginia; Original Letters Patent dated June 13, 1848.

Claim.—"Having fully set forth, in addition to the original patented specification, the importance and utility of my said additional improvements, and having referred thereto by diagrams, explanations, and letters of indication, what I designate as new and original with myself, is as follows: 1st, I claim the pecular construction of the rotary apparatus, formed of concavo-convex aprons or shields, combined with the curved prongs, the said rotary apparatus used in combination with the threshing cylinder, specifically as set forth. 2d, I claim setting the spout at about an angle of 45 degrees with the horizon, and adding the escape pipe to prevent the grain from flying about."

AUGUST 30.

74. For an *Improvement in Hot Air Furnaces;* M. B. Dyott, Philadelphia, Penna.

"This invention relates to certain improvements in hot air furnaces, and consists in the combination of the inner cylinder or flue and the drum which encircles the fire chamber, arranged as described. By this arrangement, it will be seen that the cold air, that passes into the space between the drums and fire chamber, keeps the fire chamber from being burnt; and the air itself is of course heated by the fire. The internal cylinder or flue also supplies a current of warm air, and a great heating surface is exposed. The heat from the fire chamber passing around the drums, is prevented from passing off, and communicates heat to the air within the shell."

Claim.—"I do not confine myself to any particular shape or form of air chamber or drums, whether conical, cylindrical, or otherwise; I do not claim separately, any of the devices or parts herein named; but what I do claim is, the combination of the internal cylinder or flue with the drums, arranged in the manner described, by which combination a great amount of heating surface is exposed."

75. For an *Improvement in Benzole Vapor Apparatus;* Oliver P. Drake, Boston, Mass.

"An apparatus made in the above mentioned manner, will not only be found very efficient in the production of benzole vapor mixed with air, but will produce such a regular pressure and flow of such æriform mixture through its gas burner or burners as will cause an unsurpassed steadiness in the height of the flame; besides, the luminosity of the flame is far greater than that of the coal gas."

Claim.—"I claim as my invention, the combination of the heater and gas burner, with the water vessel and vaporizing chamber, substantially as specified, so that by means of the said heater and gas burner, and the pipes connecting them with the water vessel and the chamber, the whole or part of the mixture of air and benzole vapor produced by the apparatus, may not only be used in any convenient place for the purpose of illumination, but also for heating the water of the vessel, as specified. I am aware that for the purposes of evaporating saccharine fluids, a hollow shaft, surrounded by plates and having perforations, has been made to revolve over an open cistern, (containing the saccharine liquor,) while air has been blown into such shaft, and made to pass against the plates partially immersed in the liquid and put in revolution; I therefore do not claim such. But what I do claim as my invention, and for the purpose of vaporizing benzole, or other suitable volatile hydro-carbon, and mixing it with air, is, the combination of the closed vaporizing chamber, the rotary vaporizer or disseminator, (placed therein,) and the rotary meter wheel and its closed case, or an air forcing apparatus, as made to force a stream of air into the hollow shaft of the vaporizer, and through or against the saturated portions of the disseminator, and into the vaporizing chamber and regenerator, so as to vaporize the benzole or hydro-carbon, and mix it with air, substantially as above specified. And in combination with the rotating meter wheel and its case, and the hot water vessel, I claim the coiled induction air pipe, as made to pass through the water in the vessel, and thereby receive heat therefrom, so as to warm the air as it passes through the pipe, and to supply oxygen to the volatilized vapor, and for the pupose of facilitating the evaporation of the same. And, in combination with the induction air pipe, I claim the chamber and its regulator slide and orifice, applied for the purpose of supplying cold air to the warmed air, or to the meter wheel, in order to diminish or regulate the temperature of the air passing into the said wheel, and forced into the vaporizing chamber. I also claim the peculiar mode of making the rotary disseminator or vaporizer, viz: of two perforated heads or disks, a hollow perforated shaft, and strands of lamp wicking, or other absorbent material, stretched from one head to the other, as specified. And for the purpose of an air blast apparatus, I claim the application and use of the meter wheel, its closed case and liquid therein, substantially in the manner as above specified, not meaning to claim the method of using the meter for the admeasurement of gas, and wherein the wheel of the meter is turned by the gas itself, but meaning to claim it as having its wheel operated by a separate power, and applied in conjunction with the water and closed case, and induction and eduction pipes, for the purpose of blowing air, as specified."

76. For an *Improvement in Stove Pipe Collar;* R. R. Finch, Jr., City of New York.

"The nature of my invention consists in having a collar attached to the end of the flue, which projects a short distance from the stove; one side of the collar as well as the end of the flue being beveled at an angle of 45°, by which arrangement the collar may be so placed or attached to the end of the flue, that the pipe may project horizontally from the stove, or perpendicularly from it, as desired; said collar being movable or reversible, and fitted to the flue by means of a flanch and button on the end of said flue. By this simple device, a vertical or horizontal smoke pipe may be attached to a stove without any inconvenience. In summer, when the least possible heat is desired in a room from a cooking stove, the pipe may be made to run horizontally with the chimney, leaving but a small heating surface of pipe in the room; but in winter, when heat is indispensable, by merely reversing the position of the collar, the pipe may be run vertically into a chamber above, or into the chimney at some distance above the fire place. The reversible collar also saves the expense of an elbow at the end of the flue, when the direction of the smoke pipe is changed."

Claim.—"Having thus described my invention, what I claim is, the reversible collar, constructed, arranged, and applied to a stove, in the manner and for the purpose substantially as shown and described in the body of the specification."

77. For an *Improvement in Stoves;* Thomas S. Gore, Jersey City, New Jersey.

"The nature of my invention consists in surrounding an inner cylinder or chamber of the stove with spiral flues, so arranged or connected to the base, that the heat which passes

down the spiral flues will meet or unite with a main flue or pipe connected to the ordinary smoke pipe. The arrangement of the spiral flues and base, by which a large heating surface is obtained, as will be hereafter shown, constitutes the invention."

Claim.—"Having thus described my invention, what I claim is, the spiral flues surrounding the cylinder, arranged and connected to the base, substantially as shown and described, for the purpose of obtaining a large extent of heating surface for the flues, and also for forming a space between them for the admission and heating of cold air, as set forth."

78. For an *Improvement in Conductors in Machines for Forming Hat Bodies;* Lansing E. Hopkins, City of New York.

"My improvement in forming hat bodies consists in a bifurcated conductor, so constructed and arranged as to place the exhaust cone between two jets of fur."

Claim.—"Having thus fully described my improvement in hat forming machinery, what I claim is, the bifurcated conductor and blast above described, said conductor having its openings opposite each other, or nearly so, and having the cone between them, substantially in the manner and for the purposes set forth."

79. For an *Improvement in Steam Boilers;* Benjamin Irving, Green Point, New York; patented in France, May 12, 1853.

"The improvements which are comprehended in this invention have in view, chiefly, to secure a more perfect combustion of the gases generated by the consumption of fuel, and to present a large extent of heating surface without subjecting any part of it, when working properly, to a very intense heat; to guard against explosions of the boiler; to gain more compactness and strength in structure, and to diminish the necessary weight of metal and quantity of water. The results claimed for these improvements are, economy in amount of fuel and in expense of construction, safety from explosions, increased strength and durability, and adaptedness for the use of coal or wood to propel engines on railroads, and for all other purposes."

Claim.—"What I claim is, 1st, A boiler composed of an external water-jacket, of cylindrical or other form, with a steam chamber at the top, and with or without one or more inner water jackets connected with the outer water jackets, substantially as described, when either water jacket contains one or more vertical coils of steam pipe, whose lower ends connect with one of the water jackets, and whose upper ends discharge into the steam chamber, substantially as set forth. 2d, Drying the steam by passing it through a coil within or between the water jackets, substantially as set forth."

80. For an *Improvement in Cider Mills;* John Krauser, Reading Pennsylvania.

Claim.—"I do not claim as of my invention, the employment of two or more pistons or plungers, in combination with the grinding cylinder, nor operating them by the machine itself, whether the motion derived therefrom be uniform or not; but what I do claim is, in the first place, so arranging the hopper with reference to the several operating parts of the machine, that the fruit or other substance contained therein, shall not rest directly upon or against the roughened exterior of the grinding cylinder, but directly upon so much of the upper surface of the anterior ends of the pistons or plungers as shall be found operating or exposed within its enclosed sides, for the purpose of agitating the incumbent substance, so as to insure and facilitate the filling of the cells, as the pistons recede from the cylinder. And, in the second place, which is a consequence of the first, viz., to cause the incumbent substance to press upon the cumbent, or that contained within the cells, so as to oppose the upheaving or ejectment of the same whilst in the act of being pressed against the passing teeth of the revolving cylinder by the action of the alternating pistons or plungers, as herein more fully described and set forth."

81. For an *Improvement in Hemp and Flax Breaking Machines;* O. S. Leavitt, Maysville, Kentucky.

Claim.—"Having described the construction and operation of my invention, I do not wish to be understood as limiting myself to the precise construction and arrangement of parts herein specified, as I have only described the mode of application which I have essayed with success. What I claim is, the combing apparatus as described, in connexion with the pieces which move alternately up and down, to hold the hemp or flax against the action of the combs."

82. For an *Improvement in a Machine for Distributing and Composing Type;* Wm. H. Mitchel, Brooklyn, New York.

"The nature of my invention consists in means for distributing the types from the forms,

and setting them up in rows within grooves, a given letter in each row, with the faces of the types upwards, and the bottoms of the types in a line; from which grooves the types are removed, each row of a given letter at a time, and placed within slides or conductors which supply them to an apparatus connected with the finger keys. The striking of any given finger key drops one of the corresponding types on one of a series of belts, which are moved by competent pulleys. This series of belts is elongated as the latter approach the delivery end of the machine, and is combined with a diagonal belt, so that any given type dropped on any one belt, takes an equal time to reach the point of delivery, that is, the composing apparatus, and consequently the types, reach that point in the same order in which they are dropped by the finger keys. This is effected by the diagonal belt aforesaid, to which the types are transferred from the series of belts by means of small shoots, this diagonal belt carrying all the types to one point of delivery, where, by means of a conductor and composing wheel, they are set up in a line ready to be placed in the galley in lines of the required length, for transfer to the composing stone."

Claim.—"I do not claim arranging the composing apparatus so that each type has to travel nearly the same distance to the point of delivery from the point at which it is dropped, as this has been effected by grooves; but I am not aware of any apparatus in which a combination of belts has been arranged with a view to all the types taking an equal time to travel from the point of deposition to the point of delivery, thereby carrying the types with certainty, and avoiding all liability to stick or get into disorder. I do not limit myself to the precise arrangement of the belts, as long as the same end is attained; neither do I limit myself to the number or size of the parts, as these must be varied to suit the types, and the capacity required; but what I claim is, 1st, The feeding belt or belts, combined with the inclined plane, wheels, and grooves, to distribute the type in the manner specified. 2d, The mode herein shown for forming the distributing stick, with the points, spring, lips, and keys, so as to drop one type at a time on its side, as specified. 3d, The bridge and form of groove to separate the thick from the thin types as they slide down the incline, as specified. 4th, A series of belts of length increasing towards the point of delivery of the types, in combination with a diagonal belt to receive and convey the said types from the series of belts to the composing table or other point, in the order in which the types are dropped on the series of belts, as specified. 5th, Fitting the key for dropping the types so that it shall give a partial rotary motion to the shaft, to operate on the fork, or any analogous device to drop the types. 6th, The fork and blocking piece or stopper, to drop one type at a time when moved by the key, or any similar means, as specified. 7th, The composing wheel, to receive and set up the types, either in the composing or distributing apparatus, as specified, and I claim the combination of the said wheel with the fingers on the wheel, or with the bar, to supply said wheels, as specified."

83. For an *Improvement in Grain Harvesters;* Frederick Nishwitz, Williamsburgh, New York.

"This invention relates to certain improvements in reaping or harvesting machines, and consists, 1st, In a pecular construction and arrangement of cutters and fingers, which will be hereafter described. 2d, In the employment or use of flanched rollers, arranged as will be hereafter shown, for the purpose of throwing or detaching the grass or grain from the discharging ends of the belts."

Claim.—"Having thus described the nature and operation of my invention, what I claim is, 1st, The combination of the fingers and cutters, or their equivalents, constructed, arranged, and operating in the manner and for the purpose substantially as herein shown and described. 2d, I claim the employment or use of the flanched pulleys, arranged as shown, for the purpose of throwing or detaching the grass or grain from the belts."

84. For an *Improved Apparatus for Grinding and Shaping Metals;* Samuel Darling, Bangor, Maine.

Claim.—"What I claim is, the combination of the holder of the article to be ground with a grindstone or grinding disk, substantially in the manner herein set forth, so that the article and the stone will change positions relatively to each other during the operation in three directions, namely, towards each other, and parallel with, and transverse to the axis of the stone."

85. For an *Improvement in Saw Mills;* Andrew Ralston, West Middletown, Penna.

Claim.—"Having fully described my improved saw mill, what I claim is, 1st, Sawing logs or other descriptions of timber into lumber by means of a reciprocating saw operated in a horizontal position, substantially as set forth. 2d, I claim such an arrangement and

combination of the horizontal saw with the other parts of the saw mill, that the saw will run through and beyond each end of the log, or other description of material operated upon, and whilst in that position, will be automatically let down a distance equal to the thickness of stuff desired to be cut, and the motion of the carriage reversed to bring the saw again into action without stopping the machine, and so on until the log or other material operated upon shall be entirely sawn into the dimensions required, substantially as herein set forth. 3d, I claim connecting the operating pitman with the saw gate, through the medium of a secondary pitman, connected with the saw frame and saw gate, substantially as described, so that the operating force shall be applied in a direction nearly coincident with that of the saw in successive positions, for the purposes set forth."

86. For an *Improved Machine for Cutting Sheet Metal;* Stephen P. Ruggles, Boston, Massachusetts.

"The nature of my invention consists in so hanging the shear or separating blades, as that their cutting edges shall be in the same line, and one so placed above the other as not even to come in contact, much less overlap each other, by which means, I can cut a perfectly straight, square, and smooth edge, without the least warping or twisting of them, and with great diminution of power, from the fact that the cutting edges need not pass into the sheet or plate more than from one-half to two-thirds of its thickness, and yet it shall be entirely separated, and with smooth edges; and also, in hanging the cutting blades, or stocks on which they are supported, upon eccentric pins or bolts, for the purpose of giving them the most accurate adjustment which they require with the varied thickness of metal sheets to be cut."

Claim.—"Having thus fully described the nature of my invention, what I claim is, the so hanging of a traversing and a fixed cutting blade, one or both, as that their cutting edges shall not overlap, or come in contact with each other, by which means I am enabled to divide sheets of metal without twisting or warping their edges, and at great saving of power, substantially as described. I also claim the connecting of the upper and lower portions of the frame, when each carries one of the cutters, on eccentric bolts, suitably provided with screw and nut, or their equivalent, for giving the blades on the said two parts of the frame a perfect adjustment, one above the other, substantially as described."

87. For an *Improvement in Paper Files;* Daniel Winslow, Westbrook, and Perley D. Cummings, Portland, Maine.

Claim.—"We do not claim a file or bill holder as made of two plates of wood or pasteboard, or metal, held together upon the file of papers by one or more elastic bands; but what we do claim is, the combination of the plates with the elastic bands, so arranged that the side edges of the top plate shall be bent down upon the bands, and hold them securely, while the side edges of the bottom plate are turned, but left far enough from the bottom plate for the bands to move freely between them and the said plate; the edge lips of both plates being bent inwards and rounded on the corners, as to protect the bands from being chafed or worn, as described."

88. For an *Improvement in Machines for Splitting Leather;* Charles Weston, Salem, Massachusetts.

"My improvement consists in an arrangement for adjusting and holding the spring plate in a novel manner, by attaching the arm which operates the cams to a spring rack, so that the spring plate will not only be susceptible of adjustment for the different thicknesses of the split, and exert a constant and uniform pressure upon the same, but will also yield to the various inequalities of the hide as it is drawn through the machine."

Claim.—"Having thus described my improvements, what I claim is, the arrangement herein above described, for exerting a constant and uniform pressure upon the leather, and at the same time allowing the spring plate to yield to the inequalities of the hide, the same consisting in a spring rack for holding the arm which is connected to the spring plate by the turning shaft and cams, as above set forth."

89. For an *Improvement in Apparatus for Purifying Gas;* William Wigston, City of New York.

"The nature of the invention consists in what I term a scrubber, which is a float of wood or other material, of circular or other form, of sufficient buoyancy to float in the purifying liquor, with an interior cavity above the surface of the liquor, and with passages leading from the said cavity through its sides, and the gas enters through the inlet pipe which rises through the liquor, and opens into the cavity above its surface, escaping through the passages through the sides. These passages are so arranged that they are

almost or entirely submerged, when there is no pressure of gas; but that when there is a pressure, the float will be raised so as to bring a small portion above the surface, to allow the escape of the gas in very thin streams, and thereby bring every portion of it in contact with the liquor."

Claim.—"What I claim is, constructing the scrubber or float with a cavity, to receive the gas above the surface of the fluid, and partly submerged passages leading from the said cavity through the sides of the float to allow the escape of the gas from the cavity, and cause its distribution over the surface of the fluid in thin streams, to produce a diffused contact with the fluid, as described."

90. For an *Improvement in Machinery for Cutting and Bending Metallic Disks;* Elliot Savage, Assignor to Franklin Roys and Edward Wilcox, Berlin, Connecticut.

Claim.—"What I claim as my invention is, the combination and arrangement of the roller with the roller and the bending roller, so as to operate together, and independently of the clamps, substantially as specified."

91. For an *Improvement in Shingle Machines;* Elijah Valentine, Palmer, Assignor to Abel Bradway, Monson, Massachusetts.

Claim.—"What I claim is, the series of rollers placed above the platform, when they are combined with the ledges which rise from the sides of that portion of the platform that receives the riven shingles to be operated upon, and so arranged that when a rived shingle is first carried forwards, the said rollers will be elevated above its upper surface by the said ledges, and when the driver is drawn back, it will at the same time pass from under the said shingle, and from under the rollers, thereby allowing the shingle to fall upon the platform, and the rollers to fall in succession upon the upper surface of the shingle, for the purpose of giving to the said shingle such a shape and position upon the platform, that it will be carried onwards again by the next forward movement of the driver, and be operated upon by the dressing knives, substantially as herein set forth."

Designs for August, 1853.

1. For a *Cooking Stove;* Julius Holzer, Assignor to North, Chase & North, Philadelphia, Pennsylvania, August 2.

Claim.—"The design and configuration of the mouldings described, forming an ornamental design for a cooking stove."

2. For a *Sewing Bird;* Allen Gerould and John H. Ward, Middletown, Conn., Aug. 2.

Claim.—"The design of an entire bird in a sitting posture, constituting an ornamental design for a sewing bird."

3. For a *Statue of Daniel Webster;* Thos. Ball, Assignor to Geo. W. Nichols, Boston, Massachusetts, August 9.

Claim.—"I claim the new design for a statuette of Daniel Webster, as described and represented in the drawings."

4. For a *Cooking Stove;* John W. Van Cleve, Assignor to James Greer & Co., Dayton, Ohio, August 16.

Claim.—"I claim the design and configuration of the ornaments for a cooking stove, described and shown in the drawings."

5. For a *Stove;* Samuel H. Sailor, Assignor to J. G. Abbott and Archilus Lawrence, Philadelphia, Pennsylvania, August 23.

Claim.—"I claim the configuration and arrangement of the ornaments in bas-relief, and mouldings on the plates and door, as set forth in the specification and drawings."

6. For a *Milk Stool Frame;* P. A. Palmer, Leroy, New York, August 30.

Claim.—"I claim the ornamental design and configuration, such as described and represented."

7. For a *Cook Stove;* Frederick Schultz, County of Philadelphia, Assignor to Charles and Samuel Gilbert, Philadelphia, Pennsylvania, August 30.

Claim.—"The configuration and arrangement of the ornaments in bas relief, and mouldings on the plates and doors, oven door, and foot, as described in the specification and drawings."

8. For a *Parlor Stove;* Garrettson Smith and Henry Brown, Assignors to J. G. Abbott, and Archilus Lawrence, Philadelphia, Pennsylvania, August 30.

Claim.—"The configuration and arrangement of the mouldings and ornaments on the front, top, and base of the stove, together with the form and configuration of ornaments on the front and urn, as set forth in the specification and drawings."

SEPTEMBER 6.

1. For an *Improvement in Straw Cutters;* James T. Asbury, Taylorsville, N. Carolina.

Claim.—"What I claim is, the combination of the three cutting knives, as described, with the recessed arms, whereby one-third of the feed of straw is cut successively by each knife, the protruding uncut portion passing through the recesses in the arms during the operation, substantially as specified."

2. For an *Improvement in Nut Crackers;* Philos Blake, Eli W. Blake, and John A. Blake, New Haven, Connecticut; ante-dated March 6, 1853.

"Our improvement consists in a peculiar arrangement of the jaws, in relation to each other, and to the axis on which the movable jaw turns; and in combining therewith stops to limit the motions of the movable jaw in both directions. Such is the joint effect of these modifications, that without any attention or caution on the part of the operator, our instrument will subject every nut to the proper amount of compression and no more, however the nuts may vary in size or hardness."

Claim.—"Having thus described our improved nut cracker, and the manner of using it, we would now state that we do not claim the use of jaws, forced together by a lever, to crack nuts, since that device is found in the common nut cracker; nor do we claim the mere divergence of the jaws, irrespective of their position, in relation to the axis of motion, since the jaws of the common nut cracker diverge when opened to receive a nut; but the jaws of the common nut cracker diverge in a plane which is at right angles to the axis of motion, and, consequently, nuts of different sizes are received between them at different distances from that axis; whereas, the jaws of our instrument diverge in a plane which is parallel to the axis of motion, and, consequently, nuts of different sizes are received between them at the same uniform distance from the axis of motion, which condition, or a near approximation thereto, is indispensable to the cracking of nuts of different sizes, between jaws whose motions are limited by stops in both directions, as described. What we do claim is, 1st, The divergence of the jaws in a plane which is parallel to the axis of motion, as herein described and shown in the drawings, whereby nuts of different sizes are all received at a uniform distance from the centre of motion. 2d, The divergence of the jaws in a plane parallel to the axis of motion, in combination with the two stops collectively, which limit the motions of the movable jaw, as herein described. 3d, The divergence of the jaws in a plane parallel to the axis of motion, in combination with their extension beyond the supports of the axis, as described and shown in the drawings, whereby the line of the axis of motion is brought in close proximity to the acting faces of the jaws, without impairing free access to them, to introduce and remove the nuts. In conclusion, we add, that in the foregoing claims we do not intend to confine ourselves to a strict parallelism between the plane of the jaws and the axis of motion, since it is obvious that some variation therefrom would not defeat the object aimed at, by approximating to parallelism, in distinction from placing the plane of the jaws at right angles to the axis of motion, as in the common nut cracker. Indeed, we have contemplated as a possible improvement, the placing the outer ends of the jaws a little further from the axis of motion than the other end, with a view to have them act on large nuts through a space somewhat greater than on small ones.

3. For an *Improvement in Machines for Edging Leather Straps;* James Barnes, Franklin, New York.

"The nature of my invention consists in constructing a machine, so that by drawing through it strips of leather of different width, they are all rounded to the same curve, so as to give uniformity to the swelling of different parts of a harness, with one knife, and without the change of any part of the machine, a single movement adjusting the gauge to any width desired."

Claim.—"What I claim is, the combination of the parallelogram and inverted dividers, as a regulating gauge, to work in front of the edge of a curved knife, so that strips of eather of different widths may be rounded to feather edges with the same perfection,

without the change of knife, or any part of the machine; the whole being constructed substantially in the manner herein described."

4. For an *Improvement in Printing Presses;* Victor Beaumont, City of New York.

Claim.—"I do not claim a type cylinder, or any particular mode of holding the type in place, or the using any portion of the periphery of the type cylinder for a distributing surface; but what I do claim is, 1st, The combination of two or more impression cylinders with a type cylinder, so arranged as to print all over on one side a continuous sheet of paper, in the manner described. 2d, The combination of the eccentric rod and the folder, so arranged as to lay the continuous sheet in piles after being printed on one side, as described. 3d, The combination of the indented knife with the roller, so arranged as to cut the sheet into proper length, as printed."

5. For an *Improvement in Piano Fortes;* Wm. Compton, City of New York.

Claim.—"What I claim is, the means herein described and shown, for securing the strings into the angles of the T's by the combined operation of the up-bearing bridge or rest to which the T's are connected, and crossing and drawing the strings together at said bridge or rest, for the purpose of relieving the sounding board or rest plank of vertical pressure, as specified."

6. For an *Improvement in Sealing Preserve Canisters;* Henry Hunt, Brooklyn, New York.

Claim.—"What I claim is, excluding air from articles put up in closed canisters or other vessels, by providing the canister or other vessel with a metallic tube, or its equivalent, attached thereto, and after the air has been exhausted through the said tube, pressing it together air tight, that it may be soldered or cemented, to render the joint permanently air tight, substantially as described."

7. For an *Improvement in Horse Collars;* Joseph R. Lindner, City of New York.

Claim.—"I claim the union of the hame plate and collar, in combination with the lock plates, substantially as set forth. I also claim the triple fastening of the lock plates, in combination with the outward and backward spring of the hame plates, substantially as set forth."

8. For an *Improvement in Straw Cutters;* John Moyle, Martinsburgh, Virginia.

Claim.—"What I claim is, the combination of the rake and holder, constructed and operating substantially as described, for feeding the straw to be cut, and binding it to the box, as specified."

9. For an *Improvement in Printing Presses;* Chas. Montague, Pittsfield, Massachusetts.

Claim.—"Having fully described my improvement in printing presses, what I claim is, such a combination and arrangement of the cylinder and bed, that whilst one sheet is receiving its impression, the sheet to receive the next impression will be carried forwards upon the cylinder nearly to the bed, for the purpose of being in readiness to commence receiving its impression the moment after the bed starts upon its next forward movement, substantially as set forth."

10. For an *Improvement in Printing Presses;* Charles Montague, Pittsfield, Mass.

Claim.—"Having fully described my improved printing press, for printing on a continuous sheet, what I claim is, the combination of the intermittently winding cylinder and feed roller, or their equivalents, with the reciprocating pressure cylinder, bed, and rollers, arranged and operating in such a manner as to successively make an impression on the continuous sheet at each movement of the bed, substantially as herein set forth. In combination with a double set of inking rollers, I also claim the arrangement of the arms for inking both sets of rollers from a fountain placed vertically below the impression cylinder, substantially as described."

11. For an *Improvement in Feed Apparatus to Gas Generators;* Stephen Meredith, Erie, Pennsylvania.

"The nature of my invention consists in the construction of a peculiar retort, by which a heated surface is constantly presented to the tar fluid. This is effected by placing within the retort a revolving cylinder, upon which the fluid drops from a perforated pipe."

Claim.—"Having thus described my invention, what I claim is, the peculiar construction of the retort, as described, viz: having the retort of the cylindrical shape, or of other suitable shape, and placing within it a revolving cylinder, which, as it rotates, constantly

presents a heated surface to the fluid, and converts it into gas, preventing the fluid from cooling the retort, and also preventing the formation of any incrustation on the same, as set forth."

12. For an *Improvement in Bottle Fastenings;* James Spratt, Cincinnati, Ohio.

Claim.—"What I claim is, the application of the cup or cavity and aperture for sealing preserved edible substances, as set forth."

13. For an *Improvement in Machinery for Planing Metals;* Wm. W. Spafford, Boston, Massachusetts.

Claim.—"What I claim is, the combination of the receiving table or plate and its arm, (composing the radial arm,) the adjustable centre pins, or their equivalents, and the brace, together with the main planing table and its supporting frame, the same being made to operate substantially as specified, and for the purpose of adapting the planing machine to planing in curved lines, essentially as herein before set forth."

14. For an *Improvement in Counterfeit Coin Detectors;* Gideon B. Smith, Baltimore, Maryland.

Claim.—"What I claim is, a gauge or hole just large enough to permit the genuine coin to pass through, arranged in combination with a lever, acting below said gauge, balanced, so that the weight of such coin will depress it, so as to let said coin slip down through said gauge, which is too small to allow any spurious coin to pass, which is larger than the genuine; the lever being so balanced that any coin lighter than the genuine will not be heavy enough to depress it; so that all spurious coin, whether too large or too light, will stop in the gauge, while the genuine will slip through and fall out below, substantially as described."

15. For an *Improvement in Cotton Gins;* Henry L. Weeks, Hannahatchie, Georgia.

Claim.—"What I claim is, 1st, arranging and securing the boxes, in which the ginning rollers operate, in a revolving or adjustable frame or box, or its equivalent, so that the rollers can be adjusted or set at such an angle as may be requisite or desirable, as the condition of the cotton or other circumstances may require, so as to discharge the seed, or facilitate its falling from the rollers, after the cotton is drawn off by the rollers. 2d, Giving to the feeding aprons, or equivalent feeding devices, different velocities, for the purpose of spreading, distributing, or drawing apart the bolls of cotton, so that sand and dirt may fall out, and not be carried to the ginning rollers. 3d, Passing the cotton, after it is ginned, between double aprons, or equivalent devices, when said apron or devices move with less velocity than the ginning rollers, for the purpose of compressing and making more compact the cotton after it is ginned."

16. For an *Improved Process for making Twisted Gun Barrels;* Thomas Warner, Chicopee, Mass.

Claim.—"What I claim is, 1st, a new manufacture of gun barrels, made out of a solid bar, with the fibres of the metal having a gradually increased twist from the inside to the outside, substantially as specified. And in the process, I claim making twisted barrels by twisting a bar of metal of the required size, when in a heated state, and then boring out the calibre, substantially in the manner and for the purpose specified."

17. For an *Improved Paddle Wheel;* Benjamin Irving, Green Point, New York.

Claim.—"What I claim is, arranging and combining the floats, so as to form a series of buckets, of rhombic or substantially similar form, as and for the purpose herein set forth."

18. For an *Improvement in Straw Cutters;* Thomas Allison, Milton, New York.

Claim.—"I do not claim cutting straw in an oblique direction by means of spiral knives, set obliquely round the periphery of a cylinder, which has its axis set parallel with the axis of the feed trough, and which operate in combination with a parallel roller; but what I claim is, the construction and arrangement of the adjustable feed roller, which is made gradually tapering from its ends to its centre or middle, in the line of a curve, and arranged at an angle to the axis of the feed trough, and made to operate in combination with the cylinder of straight knives, and thereby facilitate the operation of the machine, as herein fully set forth and described; this arrangement rendering the machine less expensive, and more easy to be managed and kept in order."

19. For an *Improvement in Corn Shellers;* Levis H. Davis, Kennett Square, Pa.

Claim.—"What I claim is, the introduction of the wheels and arms, attached to the springs and regulated by the screws, as described, for the purpose of stripping the ear of the kernels, in the manner specified. I also claim the flanches upon the gear covering, for protecting the gearing from the admission of shelled corn, as herein fully set forth."

20. For an *Improvement in Corn Shellers;* Peter Dickinson, Amherst, Mass.

Claim.—"Having described my invention, what I claim is, the combination of the revolving spring shellers with the toothed rollers, operating in manner substantially as described."

21. For an *Improvement in Iron Car Brakes;* Stephen Morse, Springfield, Mass.

Claim.—"Having fully described my improved arrangement for brakes for cars, or wherever it may be suitably applied, what I claim is, the spine, having the point of suspension and socket, with the open spaces and brace plates, in combination with the rubber, or friction surface plate, substantially in the manner and for the purpose as is herein set forth."

22. For an *Improvement in Brick Machines;* Hiram Sands, Cambridge, Massachusetts, and Gary Cummings, West Derby, Vermont.

Claim.—"We do not claim the mode of operating the mould carriage by means of a crank, acting upon bars running across or attached to the mould carriage, as that has been employed before, in the brick machine of James Dane, patented Oct. 24, 1848; nor do we claim the mode of operating the pressing piston by means of a lever, actuated by revolving cams and connecting rod; nor do we claim the arrangement thereof with the cam shaft, made to pass beneath the pug mill, and these operate the mould carriage by means of a reversing gear applied to said shaft, as the like arrangement is contained in the patent of Dane, Healy & Cummings, August 5, 1851, ante-dated January 17, 1851; but what we do claim is, the modification of such arrangement, by substituting for the shaft with reversing gear, the shaft with continuous motion, operating the carriage and producing the intervals of rest by means of the crank pin acting alternately upon the studs connected with the mould carriage, whereby we obtain greater certainty and precision of action in the machine, with greater simplicity and durability. Also, in combination with the piston and the lever, we claim the slot in the lever, the slotted bearings, and the movable fulcrum pin, the connecting fork and hand lever; the same being for the purpose of increasing or diminishing the amount of pressure of the piston on the clay in the mould, as specified."

23. For an *Improvement in Printers' Ink;* Samuel H. Turner, of Brooklyn, N. York.

Claim.—"What I claim is, the employment of colophonic tar, produced and combined substantially as herein stated, both in the manufacture of printing ink, and also as a varnish used by printers to modify the condition of their ink to suit the temperature of the weather, and the kind of work to be executed, all as herein specified."

MECHANICS, PHYSICS, AND CHEMISTRY.

On the Manufacture of Cast Steel. By Dr. Karsten.*

Chemistry had already been established upon a scientific basis by the adoption of the doctrine of definite proportions at the time when attention was again directed to the compounds of iron with carbon. With regard to these substances, so important in the arts, the law of definite combining proportions did not appear to hold good; but the per centage of carbon was greater in proportion as the carboniferous iron approximated more closely to steel, and from this to cast iron. However, there still remained a possibility of reconciling the fact with the law, by assuming

* From the London Chemical Gazette, No. 256.

the existence of a definite carburet of iron capable of combining with iron in definite or indefinite proportions, and determining its characters. Still the existence of such a carburet of iron has never yet been proved. In the course of a former investigation of this subject, I was of opinion that I had really obtained such a substance. But the evidence of subsequent experience is entirely the other way; and even if such a compound were discovered, the difficulty would not be removed, for it would still be necessary to admit that it combined in indefinite proportions with iron. It would appear as if the combination of iron with carbon in indefinite proportions does not exceed a certain limit, and that the maximum per centage of carbon is about 5·93.

The classification of the various kinds of carburetted iron, under the general names of cast iron, steel, and bar iron, is entirely arbitrary, and based upon the physical characters. When entirely free from carbon, iron is so soft that it offers but little resistance to friction, and would be inapplicable to most of the purposes for which iron with more or less of carbon is employed. By combination with carbon within certain limits, it acquires greater hardness; the elasticity and ductility are increased. The increased hardness is especially remarkable when the strongly-heated metal is suddenly cooled. This character of some carburetted iron has been made the distinction between bar iron and steel, inasmuch as all bar iron which becomes harder when suddenly cooled is by universal consent termed steel. The analyses of a great number of varieties of iron has led to the result that the per centage of carbon may rise to 0·2, or even 0·25, before the metal has become considerably harder when suddenly cooled. The purer the iron is, the greater its freedom from adventitious substances, especially sulphur, silicium, and phosphorus, the larger may be the per centage of carbon requisite to determine its hardening when cooled suddenly. The best kinds of Swedish bar iron, and that made in Germany from spathic iron and brown iron ores, do not become very hard even when containing as much as 0·35 per cent. of carbon, although the hardness is such as to justify the appellation of steel-like iron. The transition from this kind of iron to true steel is so imperceptible, that it is necessary to adopt some arbitrary means of deciding whether the metal is bar iron or steel. If the carburetted iron acquires on sudden cooling such a degree of hardness as to give sparks when struck upon flint, it may be regarded as steel; and this degree of hardness requires a per centage of carbon amounting for the less pure kinds of iron to 0·5, and for the nearly pure iron to 0·65. However, steel containing such a small per centage of carbon is always but soft steel, which, to become capable of acquiring greater hardness, must be more highly carburetted. The hardness acquired upon sudden cooling increases as the per centage of carbon increases, but not in the same proportion. For iron almost perfectly free from adventitious substances, a per centage of 1·4 or 1·5 carbon corresponds with the highest capability of acquiring hardness and tenacity. With a still higher per centage of carbon, the steel acquires greater hardness; but its tenacity is lessened and the malleability decreases so rapidly with the increase of carbon, that with a per centage of 1·75 it can scarcely be welded at all. When the per centage of carbon amounts to 1·8, it is only with great difficulty that it can be forged, although with

a very great degree of hardness it may still possess considerable tenacity. Steel which contains 1·9 per cent. and more of carbon can scarcely be forged at all, and with a per centage of 2·0 the limit between steel and pig iron appears to be reached; for such metal in the soft state, that is, before being hardened, cannot be beaten out while hot without splitting and breaking under the hammer.

Steel, in virtue of the remarkable capability which it possesses, after cooling slowly from a high temperature, of being worked like soft iron, and then acquiring a considerable increase of hardness, without loss of tenacity on subsequent sudden cooling, has become a very valuable substance for various branches of industry. However, it has not yet been possible to refer the altered condition of hardness presented by the slowly and suddenly cooled metal to any altered state of combination of the carbon and iron in steel. Such wide differences of hardness and softness as those presented by steel which has been submitted to these two modes of treatment, can only be regarded as resulting from a total alteration of its molecular structure. The conjecture that the state of combination of the iron and carbon in hardened and soft steel respectively must be very different, is rendered in a high degree probable from the circumstance that such a difference in the state of combination of the iron and carbon in the carburets with a larger per centage of carbon—the different kinds of pig iron—may be proved to exist with perfect certainty. A distinction has always been made between white and gray pig iron. These substances differ so obviously in their characters—color, hardness, tenacity, and brittleness—that the fact could scarcely have been overlooked. In addition to this, the difference in their conditions of fusion must not be overlooked, the gray kind requiring a much higher temperature than the white iron, and passing almost suddenly from a solid to a liquid state, while the white iron not only fuses at a lower temperature, but before liquefaction becomes soft, and then pasty. Before a trustworthy method of separating carbon from iron had been discovered, it was supposed that this difference in the behavior of white and gray kinds of iron was attributable to the per centage of carbon, for on dissolving gray iron in acids a much larger quantity of carbon is left than when white iron is treated in the same manner. Now, however, it is known that this inference was erroneous, and that the characters of pig iron are dependent, not upon the greater or less per centage of carbon, but upon the state of combination of the carbon and iron. The gray iron, when suddenly cooled after having been melted, is converted into white iron; and white iron, when exposed to a high temperature after melting, and gradually cooled, is converted into gray iron, without the per centage either of iron or carbon being in any degree altered. Every kind of gray iron corresponds to a white iron with precisely the same per centage of carbon; and the wholly different behavior and characters of these two kinds of iron are no longer regarded as owing to the greater or less per centage of carbon, since it is known that the gray soft iron, malleable at the ordinary temperature, is a mixture of steel-like iron with carbon, while the white, hard, and brittle iron is a true chemical compound of iron with the entire quantity of carbon present.

The analogy between the gray and white pig iron on the one hand, and soft and hardened steel on the other, is unmistakeable; but no trace

of uncombined carbon has ever been found in slowly cooled soft steel. Even cast steel, which contains from 1·9 to 2·0 per cent. of carbon, and which on account of this large per centage can no longer be forged, has never been found to contain uncombined carbon after the slowest possible cooling. It is only when the per centage of carbon amounts to 2·25 or 2·3, that carbon separates in the slowly cooled metal, and communicates to it the characters of true pig iron. If, therefore, a distinction is to be drawn between steel and pig iron, founded upon a character determined by the combining proportions, it would correspond with a per centage of carbon amounting to 2·25 or 2·3, because a part of the carbon is then separated on gradually cooling the mass. The more the per centage of carbon increases from this minimum to the maximum of 5·93, the lighter is the color of the metal and the greater the hardness of the white variety. In the gray iron, on the contrary, the quantity of carbon which separates, and which determines the darker color and greater softness of the metal, as well as the greater or less per centage of carbon remaining in a state of chemical combination with the iron, is dependent upon the more or less solidification of the melted mass. It is therefore not sufficient to know the per centage of carbon in pig iron, as ascertained by analysis, in order to form an opinion as to the behavior of the iron in question; but it is at the same time necessary to determine how much of that carbon is chemically combined with the iron, and how much is present only as a mere mechanical admixture. With regard to the metallurgical processes, the object of which is to separate the carbon from pig iron for the production of steel or bar iron, the state of combination in which the carbon exists is of far greater importance than the total per centage of this element. White iron requires for this purpose methods of processes different from those applicable to gray iron; and cases may occur in which the smelter would be obliged to convert gray into white iron, even although this has to be effected by an addition of carbon, notwithstanding that its separation is the real object of his operations.

Although in the case of pig iron it is necessary to bring it into a liquid state, in order to convert the gray and soft variety into that which is white and hard, or, on the contrary, the former into the latter by rapid or slow cooling of the metal, in the case of iron with a smaller per centage of carbon or steel, mere rapid or slow cooling, without any previous alteration of the state of aggregation, is sufficient to convert the darker colored soft steel into the whiter hard steel, and the reverse. Judging from analogy, therefore, it is highly probable that changes in the state of combination of carbon and iron take place in the hardening and softening of steel, corresponding to the different states of combination of this element in gray and white iron, although these differences in the state of combination have not yet been proved by chemical evidence to exist in the case of steel as they have in raw iron. However, the hard and soft steels have never been regarded as special varieties, and there is no greater reason for regarding white and gray pig iron as special varieties, because the differences in color, hardness, and tenacity are owing solely to the respective states of combination determined by conditions of temperature, and not to any alterations in the combining proportions. If, however, gray and white iron are regarded as special varieties, in the same

manner as graphite and diamond, it must not be forgotten that a perfectly analogous relation exists between hard and soft steels, which are not regarded as special varieties.

In the processes employed for decarbonizing pig iron and converting it into steel, it has not hitherto been possible to obtain a product of perfectly homogeneous nature. It is always necessary to sort the steel, in order to separate the harder parts containing more carbon from the softer, and these again from the steel-like iron. This absence of homogeneity in the product, resulting from the imperfection of the processes, led to an attempt to give the steel great uniformity of texture by melting. The so-called cast steel is really a much more homogeneous and trustworthy product than the raw steel, or that obtained by cementation, although its characters likewise depend upon the proper and careful selection of the material from which it is made. In consequence of the fact, that steel may be prepared by fusion, which, together with a large per centage of carbon and consequent hardness, possesses homogeneity whatever may be the degree of hardness desired, cast steel has acquired such a well merited reputation, that it is now always employed for articles in which great hardness is indispensable. However perfect the process for making cast steel may appear to be, it is still open to the disadvantage that the selection of the suitable material must be entrusted to the judgment of the workman, and consequently that however homogeneous the product, the per centage of carbon, the hardness and solidity of the steel cannot be determined with precision beforehand. Such imperfections in the practice of metallurgical operations are in every case unavoidable, when determinations of weight must be replaced by the practised eye of the workman. The per centage of carbon in the material employed in making cast steel—cementation steel—is different in every part of the section of the bars, so that the average per centage of carbon in the charge of a crucible and the product of the casting cannot be determined with precision. Although the hardness of the English and good German cast steel corresponds tolerably well with that which is required, this result is solely attributable to the perfect acquaintance of the workmen with their materials, and their careful selection of it for this particular purpose. There would be no uncertainty as to the result, if we possessed a material applicable to the preparation of cast steel in which the per centage of carbon could be calculated. The white pig iron made from pure spathic and brown iron ores, free from disseminated copper pyrites, and the per centage of carbon in which may, without any considerable error, be assumed as 5·6,* is a material of this description. The per centage of carbon in the best kinds of Swedish bar iron, and the iron which is made in Germany from pure spathic and brown iron ores, may very safely be assumed as 0·25 on the average. The above pig iron and this bar iron are the purest kinds known, containing only traces of silicium, from which likewise the cementation steel used for making cast steel is never free. Both these kinds of iron are therefore of such a nature as to enable the operator to determine beforehand with precision the per centage of carbon in a crucible-charge, and to produce cast steel of any desired degree of hardness by means of a simple calculation of the requisite proportion of

* Karsten and v. Dechen's Archiv für Mineralogie, vol. xxi. p. 501.

the two kinds of raw material. If the per centage of carbon in the melted product obtained in this way, and the characters dependent upon that per centage, should be found to agree perfectly with calculation—a question to be determined only by experiments on a large scale—it might be expected that the production of cast steel from these materials would constitute a new phase of this branch of industry in Germany; for, besides the trustworthiness of the operation, by which cast steel could be made of any desired degree of hardness and tenacity, it possesses economical advantages in the cheapness of the raw material. These advantages are for German industry of especial importance, from the circumstance that in many provinces of that country the pure white iron with lamellar facets is produced in large quantity, and not at all in other countries.

But the production of cast steel by melting together white iron and pure bar iron, appeared to be liable to an objection far greater than that founded upon the impurity of the raw material, and this arose from the doubt as to whether the product of the fusion would be homogeneous. In my *Handbuch der Eisenhüttenkunde*, (3d edition, vol. iv. p. 512,) I have already expressed an opinion that this would not be the case, and have given the reasons which make it advisable to employ cementation steel for making cast steel, in preference to a mixture of pig iron and bar iron in suitable proportions. However, the question of practicability could only be decided by direct experiment; and it was, for the above mentioned reasons, of sufficient importance to submit it to this test. Such experiments were made in the years 1846 and 1847, at the cast steel and file factory of M. Huth, at Geitebrück, near Hagen, and under the direction of the late Superintendent Stengel, M. Huth having placed his factory at our disposal for the purpose.

The melting crucibles employed were of such capacity, that from 30 to 35 lbs. could be melted at a time. The melted metal was as usual run off into cast iron moulds. The following is a brief statement of the results obtained in a great number of meltings, and the subsequent treatment of the cast steel:—

1. In the selection of the pig iron, it is of great importance to employ such as presents perfect lamellar structure, and not such as is partly fibrous or compact. The use of lamellar iron is necessary, not only in order that the per centage of carbon in the charge may be calculated with accuracy, which cannot be done with fibrous or compact iron, in which the per centage of carbon varies greatly, but likewise and especially because the lamellar iron exercises the greatest solvent action upon the bar iron, so that even a comparatively much larger quantity of these kinds is but an imperfect substitute for the lamellar iron. Consequently, good cast steel cannot be produced in this way without lamellar pig iron.

2. The extremely high temperature which bar iron requires for fusion appeared to render it necessary that it should be added to the charge in small fragments. On this account the first fusions were made with bar iron, which had been rolled into moderately thick sheets and then cut into pieces. However, it was subsequently ascertained that the solution of the bar iron in the liquid pig iron takes place without any difficulty, and that the product is equally good when thick pieces are used, so that finally masses of a cubic inch in dimensions were employed. By this

means the expense of cutting the bar iron is obviated; at the same time the iron is less oxidized, and less room is taken up in the crucible, than when it is in small fragments.

3. In order to produce a homogeneous cast steel, the highest possible temperature is necessary for the fusion. Consequently, very infusible crucibles, which are not liable to crack, are a much greater desideratum in the production of cast steel from pig and bar iron than even in the melting of steel itself. Of course, the greater the number of meltings which can be made in one crucible, the greater is the economical advantage gained.

4. The melted metal must be run off into the cast iron moulds as rapidly as possible, in order that the whole mass may cool uniformly. At the same time care must be taken that none of the slag is allowed to pass from the crucible into the moulds, for there is not time for the slag to separate from the metal; it solidifies in the midst of the steel, and renders the casting defective, and causes the bar to rend in rolling. This may be most advantageously obviated by taking the cover from the crucible while it is still in the furnace, and skimming off the slag with a ladle-shaped iron. The small quantity which then remains may easily be kept back in the ordinary way during the casting.

5. The cast steel, when allowed to cool *slowly* in the crucible, loses all coherence, and breaks down under the hammer or rollers. The cause of this appears to lie in the formation of carburets of iron, which do not remain combined with the rest of the steel containing less carbon.

6. The cast bars must, after they have cooled, be freed from all adhering granules of metal by means of a chisel. If this is neglected, the edges of the bars become broken in rolling.

7. In heating the cleaned bars for the purpose of further working, a bright red heat must be employed. This cannot be effected in a satisfactory manner before a blast, because the temperature is not sufficiently uniform, and a uniform heat is indispensably necessary for the favorable result of the rolling or hammering. This can only be effected in a well constructed reverberatory furnace, and most advantageously in one fed with gas, a slight excess of which is present.

8. It is preferable to roll the heated bars rather than to hammer them; but if a hammer is used, it must be of considerable weight.

9. The cast bars presented a perfectly homogeneous appearance, even after rolling. The bars were first rolled out square to a length of 4 feet, and then after reheating brought into the desired form. They admitted of being rolled into the thinnest sheets without cracking at the edges.

10. Even in making soft steel, for which purpose the crucible was charged with 25 lbs. of bar iron and 2 lbs. of pig iron, a perfect solution of the bar iron was effected by means of a strong heat. The product was a homogeneous steel, although, according to calculation, it could not contain more than 0·6 per cent. of carbon. The best, hardest, and most tenacious steel was obtained by fusing mixtures in which the calculated per centage of carbon was 1·5 or 1·6. For this purpose the crucible was charged with 24 or 25 lbs. of bar iron and 8 lbs. of pig iron.

11. The cast steel, even that which is soft and in which the per centage of carbon is only 0·6, differs essentially from the raw or melted steel

in the circumstance that it cannot be welded without great difficulty. With a higher per centage of carbon, it can only be welded under a coating of borax. With a per centage of 1·25, it can no longer be welded at all. Although, on the one hand, this behavior of the cast steel obtained in this way indicates its homogeneity, still it is a defect, one indeed which is likewise possessed by the English cast steel in a somewhat less degree.

12. The cast steel bears only low tempering heat, and acquires a very high degree of hardness, although at the cost of its tenacity. The proper mode of tempering it still remains to be ascertained.

13. The steel may be used for making the finest kinds of cutlery for files and chisels. For all purposes in which it is submitted to sudden and violent blows, it has proved destitute of the requisite tenacity. While very hard, it possesses considerable brittleness.

14. The last mentioned character of the steel affords ground for doubting its certainly apparent homogeneity, and this conjecture is confirmed by the fact, that its tenacity and capability of being welded are considerably increased by remelting. If, however, it should prove to be impossible to produce a good cast steel in one melting, the economical advantages of this process would probably be altogether lost.

The further prosecution of these experiments has unfortunately been interrupted by the long illness and death of Superintendent Stengel, who had for a number of years afforded me valuable aid in carrying out a variety of experiments, which appeared to me to be necessary for the purpose of throwing some further light upon the metallurgy of iron.—*Karsten and v. Dechen's Archiv*, vol. xxv, p. 218.

New Photographic Process. By John Stewart.*

Your insertion of the annexed letter from my brother-in-law, Mr. John Stewart, of Pau, will much oblige me. The utility of this mode of reproduction seems indisputable. In reference to its concluding paragraph, I will only add, that the *publication* of concentrated microscopic editions of works of reference, maps, atlases, logarithmic tables, or the concentration for pocket use of private notes and MSS., &c., &c., and innumerable other similar applications, is brought within the reach of any one who possesses a small achromatic object glass of an inch or an inch and a half in diameter, and a brass tube, with slides before and behind the lens of a fitting diameter to receive the plate or plates to be operated upon, central or nearly central rays only being required. The details are too obvious to need mention. I am, &c.,

J. F. W. Herschel.

Hanley Street, July 6.

Dear Herschel:—I sent you some time ago, a few small sized studies of animals from the life, singly and in flocks, upon collodionized glass. The great rapidity of exposition required for such subjects, being but the fraction of a second, together with the very considerable depth and

* From the London Athenæum, July, 1853.

harmony obtained, gave me reason to hope that ere this I should have been able to produce microscopic pictures of animated objects. For the present, I have been interrupted. Meantime, one of my friends here, Mr. Heilman, following the same pursuit, has lighted on an ingenious method of taking from glass negatives positive impressions of different dimensions, and with all the delicate minuteness which the negative may possess. This discovery is likely, I think, to extend the resources and the application of photography, and with some modifications, which I will explain, to increase the power of reproduction to an almost unlimited amount. The plan is as follows: the negative to be reproduced is placed in a slider at one end (*a*) of a camera or other box, constructed to exclude the light throughout. The surface prepared for the reception of the positive, whether albumen, collodion, or paper, is placed in another slider, as usual, at the opposite extremity (*c*) of the box, and intermediately between the two extremities (at *b*) is placed a lens. The negative at *a* is presented to the light of the sky, care being taken that no rays enter the box but those traversing the partly transparent negative. These rays are received and directed by the lens at *b* upon the sensitive surface at *c*, and the impression of the negative is there produced with a rapidity proportioned to the light admitted, and the sensibility of the surface presented. By varying the distances between *a* and *c*, and *c* and *b*, any dimension required may be given to the positive impression. Thus, from a medium sized negative, I have obtained negatives four times larger than the original, and other impressions reduced thirty times, capable of figuring on a watch glass, brooch, or ring.

Undoubtedly, one of the most interesting and important advantages gained by this simple arrangement is, the power of varying the dimensions of a picture or portrait. Collodion giving results of almost microscopic minuteness, such negatives bear enlarging considerably without any very perceptible deterioration in that respect. Indeed, as regards portraits, there is a gain instead of a loss; the power of obtaining good and pleasing likenesses appears to me decidedly increased, the facility of subsequent enlargement permitting them to be taken sufficiently small, at a sufficient distance (and therefore with greater rapidity and certainty) to avoid all the focal distortion so much complained of, while the due enlargement of a portrait taken on glass has the effect, moreover, of depriving it of that hardness of outline so objectionable in a collodion portrait, giving it more artistic effect, and this without quitting the perfect focal point as has been suggested.

But there are many other advantages obtained by this process. For copying by engraving, &c., the exact dimension required of any picture may at once be given to be copied from.

A very small photographic apparatus can thus be employed when a large one might be inconvenient or impracticable, the power of reproducing on a larger scale being always in reserve. Independent of this power of varying the size, positives so taken of the *same* dimension as the negative reproduce, as will be readily understood, much more completely the finer and more delicate details of the negatives than positives taken by any other process that I am acquainted with.

The negative also may be reversed in its position at *a* so as to produce

upon glass a positive to be seen either upon or under the glass. And while the rapidity and facility of printing are the same as in the case of positives taken on paper prepared with the iodide of silver, the negatives, those on glass particularly, being so easily injured, are much better preserved, all actual contact with the positive being avoided. For the same reason, by this process positive impressions can be obtained not only upon wet paper, &c., but also upon hard inflexible substances, such as porcelain, ivory, glass, &c., and upon this last, the positives being transparent are applicable to the stereoscope, magic lantern, &c.

By adopting the following arrangement, this process may be used largely to increase the power and speed of reproduction with little loss of effect. From a positive thus obtained, say on collodion, *several hundred* negatives may be produced either on paper or on albumenized glass. If on the latter, and the dimension of the original negative is preserved, the loss in minuteness of detail and harmony is almost imperceptible, and even when considerably enlarged, is so trifling as in the majority of cases to prove no objection in comparison with the advantage gained in size, while in not a few cases, as already stated, the picture actually gains by an augmentation of size. Thus, by the simultaneous action, if necessary, of some hundreds of negatives, many thousand impressions of the same picture may be produced in the course of a day.

I cannot but think, therefore, that this simple but ingenious discovery will prove a valuable addition to our stock of photographic manipulatory processes. It happily turns to account and utilizes one of the chief excellencies of collodion, that extreme minuteness of detail which from its excess becomes almost a defect at times, toning it down by increase of size till the harshness is much diminished, and landscapes, always more or less unpleasing on collodion from that cause, are rendered somewhat less dry and crude.

A very little practice will suffice to show the operator the quality of glass negatives, I mean as to vigor and development, best adapted for reproducing positives by this method. He will also find that a great power of correction is obtained, by which overdone parts in the negative can be reduced and others brought up. Indeed, in consequence of this and other advantages, I have little doubt that this process will be very generally adopted in portrait taking.

Should your old idea of preserving public records in a concentrated form on microscopic negatives ever be adopted, the immediate positive reproduction on an enlarged readable scale, without the possibility of injury to the plate, will be of service.

I am, &c., John Stewart.

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*Application of the Pendulum to the Determination of Velocities.**

The invaluable instrument which we call a pendulum has been applied to an infinity of objects, and always with characteristic advantages in point of precision or sensibility. It was only recently that by a new application of it, the most lofty in its object, and the most ingenious in its nature, it was made to render visible the rotation of the globe. Per-

* From the London Mechanic's Magazine, June, 1853.

haps it was in reflecting on this elegant experiment that I have been led to the thought of another kind of application, which, without participating in the same elevated character, recommends itself by having in view an end of real utility, that end having reference to the determination of velocities. And although I may not as yet be in a condition to confer upon this new employment of the pendulum the seal of practical trial, as, nevertheless, the principle of it seems to me sufficiently demonstrated by experiment, I ask that the Academy will permit me to make it acquainted with its nature in a few words, in order, in the first place, to draw its attention to a view which appears to me new, and, in the second place, in order to protect our priority during the course of experiments and of researches, which may possibly have rather a long duration.

The question with which we are dealing is, the application of the pendulum to the measure of the real velocity of vehicles; that is, their velocity referred to the centre of the earth. In everything that concerns navigation, the importance of such an object will be immediately perceived. There exist, indeed, several precise and convenient means of measuring the speed of trains on railways, for example, where the point of support between the wheel and the rail remains fixed, (as distinguished from slipping,) it is sufficient to be able to assign the rapidity of rotation of the wheels. But at sea the case is very different. The sea is subject to currents, of which the extent, the direction, and the velocity are never but imperfectly known. The sustaining point is thus itself transported in one direction or the other, and the log, the only elementary and non-astronomical means of measuring the speed of ships, gives, under any circumstances, only the difference between it and that of the surface of the water. On the contrary, it is possible to ascertain the real speed of the vessel by the indications of the pendulum, of which I am about to endeavor to explain the principle.

Suppose that a pendulum beating, say half-seconds, and carrying a bob weighing a few grammes (a gramme is equal to 15·44579 grains Troy,) be suspended in such a manner that its plane of oscillation may be parallel to the axis of progression of the vehicle. If the pendulum be vertical, the bob and the point of suspension being subjected to the same velocity, it would remain in the same state for an indefinite period, making abstraction of irregularities of motion, and derangements of various kinds. But if, by a small impulsion given by the hand in a direction contrary to that of the motion of the vehicle, the bob be made to recede a little from the vertical, the velocity of the point of suspension then produces upon it a tractive force through the instrumentality of the rod, which has become inclined to the horizon. That traction has a horizontal component, and ought, consequently, to draw forward the centre of the little mass, with a force proportionate in its intensity to the speed of the vehicle. In falling back again, and after having retrogressed a little behind the vertical, as soon as the obliquity of the rod has become sufficient, the same traction will exert itself anew, and the bob will recommence the same oscillation forwards, under the influence of the two forces of traction and gravity. Without knowing precisely the law of these two combined actions, we may nevertheless conjecture that the pendulum, under these

circumstances, would take a deviation forwards, great or small in proportion to the velocity of traction, and remaining sensibly constant if the same speed were maintained. An experimental graduation might then teach how, for a pendulum of given length and weight, to measure the speed of the vehicle on which it was carried, by observing its deviation in front of the vertical.

Such is the principle on which I have reflected, and which I have desired to subject to experiment, to recognise, in the first place, its reality, and then the possibility and the sensibility of a measure so contrived. Moreover, it is very easy to obtain this verification by an experiment to some extent manual, I not having been able, as yet, notwithstanding several attempts, to construct an apparatus capable of going by itself continuously, and destroying the effect of the various kinds of derangements and irregularities which the hand can extinguish. I do not attempt in this place, therefore, to give an exact measure of the phenomenon, but only to prove the principle of it by an experiment easily reproduced, and which, from being deprived of elegance, is not in substance less decisive.

If we get into a railway carriage, and resting our arm against a vertical support, hold a pendulum suspended in connexion with a graduated arc of a circle, in conformity with the conditions indicated above, and if, with a proper amount of attention, we preserve this instrument as much as possible from the effect of lateral shocks and vertical movements, we may observe the following result: We shall hardly have given to the bob a slight retrograde impulse, than, under the influence of traction, we shall see it almost immediately spring forwards through an angle which, for an ordinary speed of 28 miles an hour (10 *lieues*), will soon increase to about 33 degrees. In falling back, on the contrary, the backward deviation is hardly 5 or 6 degrees, and the same motion continuing so long as the velocity lasts, there is thus a very considerable and permanent inequality between the two branches of the oscillation. This is, in some degree, the characteristic part of the phenomenon. If, in this state of things, the velocity of traction should diminish, the direct deviation diminishes nearly as rapidly; and I have never failed, in experimenting in this manner, to become aware of my approach to a station, without taking my eyes off my pendulum.

The inequality between the two branches of the oscillation is also sensible for inferior velocities, and for less than 28 miles an hour, and we still see the pendulum advance 10 degrees before the vertical. The rate of ships being ordinarily comprised between 6 and 18 miles per hour (2 and 3 *lieues*), the variations of amplitude corresponding to such velocities have a very appreciable sensibility. That sensibility, besides, is susceptible of augmentation, by varying the length or the weight of the pendulum. I am not able at present, however, to say anything certain on the subject. It is clear that there must be certain dimensions which will belong to the maximum of effect; but as to that, experiment does not always bear out suppositions of a complicated and difficult nature, and it is experiment that will have to pronounce.

If we wish to arrive at true precision in the kind of measure of which I have been speaking, the great and real difficulty lies evidently in the construction of apparatus capable of protecting the point of suspension of

the pendulum, whether from jerkings and shocks on a railroad, or, above all, from the pitching and rolling of a ship. It is upon this point that my researches are being directed. Already I have made some attempts, and it was to try to combine these several dispositions that I seek to improve our prospects, as regards time, by this communication. Perhaps it never will be possible to obtain an apparatus of continuous action, nor an apparatus capable of working independently of the manual address of the operator. But many very useful instruments are precisely in the same condition; and with regard to continuity, it will be sufficient for me to call to mind, that in ships in motion it is only customary to throw the log three or four times a day. If, however, we should only succeed in affording the means of measuring speed in calm weather, in an intermittent manner, and even under conditions essentially manual, but with a light instrument, of elementary simplicity, easy to construct and to repair, I think we shall have attained an end of unquestionable utility, and it is the hope of that result that attaches me to the prosecution of this research.

For the Journal of the Franklin Institute.

Evolution of Steam.—Experiments Proposed.

Among the countless attempts at economy in the steam engine, I am not aware of any that have for their object a more rapid evolution of vapor by introducing in small quantities into boilers, a thinner and more evaporable liquid than water; one that by penetrating the latter shall render it more permeable to and be the medium of more rapidly and intimately diffusing heat through it. A crude preliminary experiment or two, in which small doses of whiskey were tried, resulted in nothing definite, one way or the other, on account of the lame apparatus employed, and the pressure of other engagements at the time. Circumstances have hitherto prevented their resumption under better auspices. The subject is commended to the attention of chemists.

It may, perhaps, be a question with some, whether there exists, or is attainable, a cheap liquid possessing the qualities named; but there is no doubt that a fluid which is every where abundant, and costs nothing, greatly accelerates the evaporation of liquids, when passed through or mingled with them, viz: common air; and to determine the profit or loss attending its use in steam boilers, was another object postponed. Will not some readers of the *Journal* adapt an air-feeding apparatus to a boiler, and give us the results? I presume it would be well (to secure a pretty uniform discharge of the fluid) to have a reservoir, like a small soda fountain, between the feed pump and the boiler. The tube within the latter should be continued along the lower part, and be perforated laterally with small openings, that the issuing air may minutely agitate, break, and, in a manner, comminute the heated liquid it touches.

The increased volume of the air will, it is supposed, pay the cost of injecting it, and of the heat taken up by it, leaving the benefit of accelerated evaporation, whatever it may be, a clear gain. E.

*Art-Manufacture.**

We are under a sort of conditional promise to our readers, who feel all the value and importance of the results obtained from the Great Exhibition, to return to the encyclopædic volume which contains the records of that unparalleled display. The Great Industrial Exhibition at Dublin has naturally turned back our thoughts to our own Great Exhibition, of which it is a worthy follower. The Dublin Exhibition has a much larger proportion of Fine as compared with Industrial Art than had that in Hyde Park; and the genius of the Irish nation makes it more than probable that she will, in time, be eminent amongst the united nations in applying fancy and taste to the productions of the artizan. For this reason, we turn to-day to the Report of the Fine Arts Department of the Exhibition in Hyde Parke;—which may be looked on as one of the proximate causes of the deep interest that the subject of Art-education has recently excited in the public mind. But there is another circumstance which induces us at this moment to recur to the Report of the Fine Arts Committee:—namely, the move made by the Lord Mayor of London towards enlisting the corporate bodies of the United Kingdom in the interest of Art education. In a few days, the representatives of a large number of the great towns in the three Kingdoms will assemble at the Mansion House to discuss the modes by which artizans may be best assisted in obtaining such an amount of artistic education as will enable them to compete with the workmen of other nations, where more attention has been given to the study of ornament and its application to manufacture. We hail it as a sign of the times, that such a subject should occupy the attention of mayors and aldermen; and we think we shall be assisting the movement by calling attention to the judgment which has been passed by well-qualified persons on our present position with respect to Practical Art.

The great importance attached by the Royal Commissioners to this department of the Great Exhibition, and the sense entertained by them of the value of the lessons which it could furnish, are evinced by the prominence given to it in the Reports before us. Each of the other classes of that magnificent collection which existed but the other day on the spot over which the plough has recently passed, is dealt with in a single Report; but in this case we have, in addition to the categorical account by Mr. Panizzi, the reporter of the Jury, a Supplemental Report by Dr. Waagen, Director of the Museum of the Fine Arts at Berlin, and a "Supplementary Report on Design," by Mr. Redgrave, R. A., who had long been connected with the Schools of Design here, and who is now Art-Superintendent of the new Department of Practical Art at Marlborough House.

The Class, as our readers will doubtless well remember, included sculpture, models, the plastic arts, and ornament generally. It is not our intention, on the present occasion, to touch on the province of High Art, except incidentally. We confine ourselves just now to that part of the Report which refers to Art in connexion with manufactures and with public taste.

* From the London Athenæum, May, 1853.

We have felt compelled frequently of late to draw attention to the great want of artistic education in England;—a fact not gratifying to our national vanity to admit,—but which, being proved, demands to be discussed until efficient means shall have been taken to supply it. The Reports to which we have referred place the matter beyond doubt,—and at the same time point out the course that should be pursued under the circumstances. The evidence of so eminent a foreigner as Dr. Waagen is of great value, and his testimony against us has the greater force from the fact that he is amongst all the critics who have written on the subject perhaps the most lenient in his judgments on the productions of this country.

In his opening remarks, the Doctor dwells on the intimate connexion between Manufacture and the Fine Arts. In the great markets of the world, he says, those productions which, in addition to the indispensable requisites, exhibit the best taste in their design and treatment, will be preferred. He anticipates as one of the good results of the Exhibition a fuller revival of that happy alliance between the Fine Arts and Industry which subsisted in the Middle Ages, when the artist was more of a craftsman—the craftsman more of an artist—than is the case at present; and he refers to the wonderful specimens of casting in bronze, iron, and zinc —an art as regards the two latter metals only recently perfected—which were to be seen at the Exhibition, as affording striking examples of the co-operation of Art and Manufacture in our day. He adds:—"To the present age are also due two most valuable and original inventions by which works of the sculptor may be reproduced;—in the one case by means of galvano-plastic deposit,—in the other by the mechanical processes of M. Collas, in France, and Mr. Cheverton, in England. The cheapness with which the noblest works of Art can be multiplied by means of these inventions cannot but tend to the more general development of a feeling for the Beautiful. Of Mr. Cheverton's elegant reduction of the Theseus in the Elgin collection, he says, it "has been reduced by this process in alabaster, for the purpose of casting in plaster, with an accuracy which leaves the most fastidious critic nothing to desire." And he adds:—"The benefit which all lovers of Art, and more particularly artists themselves, will derive from this discovery, are so obvious, that I need not further insist on them here." This part of the subject is further illustrated in the remarks on the productions of Minton, Copeland, Meigh, Wedgwood, Bell, and other China manufacturers, and on the great influence that they must have in creating a correct taste by making the public acquainted with such exquisite productions as the celebrated silver cups in the Museo Borbonico or the Farnese Flora, and generally in the judicious choice and adaptation of beautiful forms from the antique.

The Jury, through their reporter, Mr. Panizzi, touch on the same subject; and allude to the fact, that the best models are daily introduced to the public by new applications of cheap materials and economic processes to the multiplication of works of Art: thus affording to the many new and pure sources of enjoyment which have hitherto been within the reach of only the more fortunate classes. It is well remarked that such a diffu-

sion of good taste cannot possibly be without a beneficial effect on the productions of industry generally.

Mr. Redgrave, in the opening of his Report, alludes to the desire evinced by the rudest as well as by the most civilized nations for decoration, as raising ornament almost to the rank of a natural want. He dwells on the great importance of its proper application by the manufacturer, and on the necessity of bringing criticism to bear upon the subject, so as to prevent the untutored eye from being attracted by the meretricious style of ornament unfortunately so common, rather than by the more modest appearance of simple and elegant forms.

In commenting on the articles in the several divisions of the Class, the reporters take great pains to indicate the principles on which ornament should be applied. In the case of designs for printed and woven fabrics, for embroidery, and for bookbinding, the designs must not disturb the flatness of the surface upon which they are drawn, but only diversify it by lines agreeable to the eye and by harmonious coloring. In such designs no foreshortening or perspective is admissible. Paper hangings covered with elaborate architectural designs, conveying the idea that the observer can see through and beyond the surface into space, curtains covered with huge flowers which are contorted by every fold in the fabric, books with Gothic churches on their covers, and carpets in which the surface appears covered with objects thrusting obstructions at every step, are severely condemned as gross violations of good taste. In the fabrics of India, the patterns and colors diversify plain surfaces without destroying or disturbing the impression of flatness; as is the case also in the productions of the Middle Ages, when the decoration of walls, pavements, and carpets was brought to such perfection by the Arabs. These productions are nevertheless remarkable for the rich invention shown in the patterns; and the beauty, distinctness, and variety of the forms, and the harmonious blending of severe colors, call forth the admiration of all true judges of Art. "What a lesson," says Dr. Waagen, "do such designs afford to manufacturers, even in those nations of Europe which have made the greatest progress in industrial art?"

Speaking of paper and other hangings, Mr. Redgrave points out the necessity for attentively considering the intention of such decorations. Like the background of a picture, they should be so subdued as not to come into contrast with the objects which they are intended to exhibit, not to rival. A wall decoration is the background for the furniture, the objects of Art, and the occupants of the room. It may, by presenting a glaring appearance, detract from their effect, but it cannot properly supply their place, however attractive or showy it may be in itself. A combination of many colors materially increases the expense of a paper, while it does not produce the same good effect as may be obtained from two or three colors carefully selected, and frequently results in an appearance of poverty and meanness. It is quite certain that the walls, floor, and ceiling of a room should not eclipse its contents; but looking upon the excessive ornamentation which is at times lavished on the ceiling, the glowing colors with which many of our paper-hangings are covered, and the flowers, fruit, animals, and birds that shine out from some of our

carpets, it is difficult to conceive a room furnished with such magnificence as not to suffer by the vicinity of such showy productions.

Few, if any, of the European nations escape censure on some of the points to which we have referred; but Dr. Waagen—impartial as he is —arrives at the conclusion, "that in many kinds of manufacture the English productions, both in regard to their form and color, show far less taste than those of other nations."

The cases in which our inferiority is most conspicuous, are those in which the ornamentation is effected wholly by machinery. This partly arises from the facilities which machinery gives to the manufacturer, enabling him to produce the florid and overloaded as cheaply as the simple forms, and thus to satisfy the craving of the multitude, who value a decoration according rather to the quantity than to the quality of its ornament.

As an instance of this vicious style, Mr. Redgrave refers to some paper hangings exhibited as specimens of the lately introduced processes of printing by such machinery as is used for cotton goods, and of applying many colors from one block. The new processes offer the means of applying a large number of colors at a small expense; and as a large number of colors is unfortunately popular in the market, this new and ingenious mode of printing is likely to have a very bad effect upon the cheaper sorts of paper hangings.

It may at first seem strange, that when articles are to be produced by thousands and tens of thousands, manufacturers should not be particularly careful that the original design, at any rate, is as good as can be obtained: but in the race for the lowest price, every extra pound expended adds something to the cost per yard, and the odd farthing is the advertisement that brings the millions to the cheap shop. There can be no doubt that half the ornament at the Great Exhibition was in excess,—that is to say, a better effect might have been produced without it; and the labor thus wasted might, in many cases, have been bestowed on the more careful completion of simpler designs, to the enriching of the manufacturer and the great advantage of the public taste.

The productions of English manufacturers are pronounced by the Reporters to exhibit at once too great a love for ornament and a want of inventive ingenuity. The consequence of this is, that there is no special style in their productions. One class worship at the mediæval shrine, and adapt the forms of the early workmen to everything that they produce: others go to the classic regions of Greece and Rome, and raise to the dignity of models everything that is stamped with the seal of antiquity—no matter whether he who originally produced it was a man of taste, or some unknown provincial artist whose productions would have been viewed by the *savans* of his time in much the same light as a well-educated architect of our own day regards some of our curious specimens of "Builders' Gothic," Grecian or Egyptian. These are the artists who hold by tradition, and look on the past as the source of all that is deserving of imitation. Another great section of ornamentalists—indeed of the professors of high art also—discard all the works of their predecessors,

and, determined to create for themselves something of a novel character, seize upon the beautiful forms of nature, and use them as the raw materials of everything which they wish to be produced.

To be Continued.

For the Journal of the Franklin Institute.

Particulars of the Steamer Golden Age.

Hull built by Wm. H. Brown; machinery by the Morgan Iron Works. intended service, Australia.

HULL.—Length on deck,	270 feet.
Breadth of beam, at midship section above the main wales,	43 "
Depth of hold,	24 " 4 inches.
Length of engine and boiler space,	92 "
Draft of water at below pressure and revolutions,	14 " 9 "
Area of immersed midship section at this draft,	552 square feet.
Capacity of coal bunkers, in tons of coal,	600
Draft of water at load line,	17 feet.
Floor timbers at throats, moulded	18 inches.
do. do. sided,	12 "
Frames, distance apart at centres,	36 "
Masts and rig,	Barque.
Tonnage,	2376 tons.
ENGINE.—One Vertical beam.	
Diameter of cylinder,	83 inches.
Length of stroke,	12 feet.
Maximum revolutions per minute,	16
BOILERS.—Two, double boilers, drop flue, with furnace at each end, and one connexion in the centre.	
Length of boilers,	38 feet.
Breadth "	14 " 9 inches.
Height " exclusive of steam chimney,	12 "
Number of furnaces in both boilers,	16
Length of grate bars,	6 "
Number of flues,	(main flue,) 8
Internal diameter of flues,	16$\frac{7}{8}$ inches.
Diameter of smoke pipe,	8 feet 4 inches.
Height of smoke pipe,	41 "
Maximum pressure of steam in pounds,	25
Description of coal,	Bituminous.
Consumption of coal per hour,	1$\frac{5}{8}$ tons.
Area of flue and fire surface in boilers,	5854 feet.
WATER WHEELS.—	
Diameter,	34 feet 6 inches.
Length of blades,	9 " 6 "
Depth of blades,	1 " 11 "
Number of blades,	28

Remarks.—Strapped with diagonal and double laid braces, $5 \times \frac{3}{4}$ inch; coppered.

Translated for the Journal of the Franklin Institute.

Analysis of a Report by a Government Commission, on Experiments made on board of the ship Du Trembley, *upon the use of the combined vapors of Water, Ether, and Chloroform.*

The ship *Du Trembley* is of iron, arranged for carrying both passengers and freight, and to run both by sails and by steam.

It can accommodate 100 travelers, and carry 230 tons of freight; an elegant schooner rig, and a screw moved by machines of 70 horse power, are so arranged as to be used either together or separately.

The peculiarity of the *Du Trembley*, which is the motive for the report upon its first trip by the undersigned members of the Committee of Superintendence of Marseilles and Algiers, is that its machines are arranged to work by the combined vapors of water and ether.

The employment of these two vapors to give motion simultaneously to the same machine, is a new system due to M. Du Trembley, whose name has been given to the ship of MM. Arnaud and Touache, the first to which it has been applied.

Struck by the loss of heat by steam in ordinary machines, after its expansive force has been exhausted, M du Trembley determined to retain and utilize it. For this purpose he proposed to employ it in forming a second vapor, whose force should be added to that of the steam.

Sulphuric ether requiring but a feeble heat to volatilize it, appeared to him fitted to realize his idea; he made the experiment, and the result fulfilled all his hopes. As soon as the vapor of water was in contact with the ether, it fell instantly in the liquid state, and the ether evaporated. On the one hand, a new expansive force was created; on the other, a vacuum, which is also a force, was formed.

The problem which M. du T. had proposed to himself, was theoretically and successfully resolved; it still remained for him to devise the mechanical apparatus by which he might apply in practice the result which he had obtained; he has been not less fortunate in this second part of his work than the first.

He receives the expanded steam, that is, after its force is expended, at its issue from the cylinder, in a closed apparatus, traversed vertically by a considerable number of small cylinders, close together, but isolated. The feet of these small cylinders plunge into a reservoir of ether placed under the apparatus which receives the steam; the ether rises in the tubes, and partially fills them.

As soon as the steam has penetrated into the apparatus traversed by the tubes, and has surrounded them entirely, the phenomenon of which we have spoken takes place; the water condenses, the ether vaporizes. The water in condensing produces a vacuum, which adds to the expansive force of the steam by suppressing the resistance which it would have encountered; and the vapor of ether collected in a separate compartment above the vaporizing apparatus into which the tubes open, developes a new force, which is added to that of the steam.

The condensed water is pumped back into the boiler, carrying back with it all the heat which the ether has not taken from it.

The vapor of ether is led into a separate cylinder used for it alone, but not differing in any respect from the steam cylinder; in this cylinder its force is utilized. The piston of this second cylinder may act either independently or may be connected to the same shaft as that of the steam cylinder; in this latter case the two vapors unite in the same work. This is the case in the *Du Trembley*, and ought to be the case in the applications of the new system to navigation.

The vapor of ether, which for many reasons it is very important not to lose, or to suffer to escape, is treated as the steam was; it is introduced into the tubes of an apparatus, like the vaporizer, whence comes a continuous jet of cold water, which fills the apparatus and surrounds the tubes as the steam does in the vaporizer.

The ether restored to the liquid state, is pumped back into the vaporizer, as the condensed water was into the boiler, to recommence the circulation we have described.

Such is the system of combined vapors due to M. du Trembley; succinct as is the description of it which we have given, it will be sufficient to explain the principle upon which the system rests, and to show that there may result from its application a notable diminution of combustible compared with that required for steam alone.

In the course of our trips, we made experiments on the quantity of fuel consumed. They lasted altogether 36 hours and 50 minutes, and took place very nearly in all kinds of weather, and under all conditions; besides, whatever was the state of the weather and of the wind, whether the machines alone drove the vessel, or whether they were assisted by the sails, the force which they expended was nearly constant, and about 70 horse power, as was indicated by the very slightly changeable position of the indexes of the manometers which measured the pressures and vacuums.

The quantity of fuel consumed in the 36 hours 50 minutes, during which our experiments lasted, was 2860·9 kil., regularly and carefully weighed; that is, as a mean 77·67 kil. per hour, or 1·11 kil. per horse power, admitting that the power of the machines was 70 horse, or 1·16 kil., if we count them but as 67 horse power, (1·11 kil.=2·5 lbs.)

Before working with the combined vapors, the engines of the *Du Trembley* were worked under the same pressure, and consequently with same force, with steam alone acting in the two cylinders. They consumed, according to the ship's log and the books of the furnishers, for 2818 hours of heating, 851·95 kil. of fuel; per hour, 302 kil.; per horse power, 4·31 — 4·51 kil. (9·5 — 9·9 lbs.)

According to this calculation, there will have been obtained, by the introduction of the vapor of ether, an economy of fuel, on that expended when the two cylinders were driven by steam alone, of 3·2 to 3·35 kil. per hour, or per horse power 74·26 per cent.—a result so good that we scarcely dare believe it, notwithstanding that the exactness of the numbers on which our calculations are based has been again affirmed to us, and differs little from that which our own experiments give.

We found the consumption of charcoal 1·11 kil., or 1·16 kil. per hour per horse power; the best constructors do not go below 4 kil., as that stipulated in their contracts as the minimum consumption of their en-

gines, which shows an economy of 2·89 kil., or 2·84 per horse power per hour, or from 71 to 72·25 per cent., a result but little below the preceding.

Besides, whether this calculation and its results be more or less rigorously exact, which further experiments will show, we consider it as settled and incontestible that, in reference to the consumption of fuel, the system of M. Du Trembley presents a notable economy; and that the expense of the ether, far from counterbalancing the advantages of this economy, scarcely changes the result.

As to the dangers inherent in the use of ether, they are the same, neither less nor greater than those belonging to lighting by carburetted hydrogen gas. The same arguments may be used against the employment of ether in steam engines as were presented when the lighting by gas was discussed. These arguments will avail no more now, than they did then against real advantages, and a remarkable economy.

One of the greatest difficulties which the inventor had to overcome was, the exact and sufficient closure of the joints, for the subtlety of ether and the ease with which it inflames are known. But M. Du Trembley has succeeded in closing the joints of his apparatus with such accuracy, that he can affirm, say the committee, that if a slight odor announces the presence of the ether when the engines, already heated, are at rest, this odor entirely disappears when the ship is in motion.—*Cosmos, 12th August,* 1853, *p.* 269.

For the Journal of the Franklin Institute.

Chloroform Engines.

The French Journals record a successful experiment at the port of L'Orient, with a steamship of 120 horse power, (the *Galileo*,) using the vapor of chloroform. No details are given of velocity or power; but it is said that her apparatus occupies but half the space of that of ordinary steam vessels, and that an economy of 50 per cent. of combustible was obtained.

We will wait for the details of the experiment, and for a larger experience as to the loss of chloroform, before we give our implicit credence to this economy.

Translated for the Journal of the Franklin Institute.

Chinese Magic Mirrors Explained.

A great deal of attention has been given in Europe to certain metallic mirrors fabricated in China—in which forms of letters, flowers, and animals are embossed on the back, which is not polished. On looking directly and as closely as possible on the polished face, no trace of these figures is seen; but if the mirror is made to reflect the rays of the sun upon a wall or screen, the ornaments on the back are plainly seen in the reflected light. Many attempts have been made to explain this phenome-

non, but hitherto unsuccessfully. On the 1st of April, however, M. Biot exhibited to the Academy of Sciences in Paris, one of these mirrors, made by M. Lerebours. It appears that in 1847 MM. Arago and Biot suggested an explanation, founded on the fact, that as the embossing of the back surfaces gave different thicknesses, and therefore different resistances to the metal, when the face came to be polished, the surface opposite the raised portions would be more resistant, and would be raised in a convex form, while that opposite the hollow would under the same pressure be slightly concave—these effects being so slight as to be invisible to an ocular examination of the surface, but becoming manifest by the deviations impressed on the reflected rays. To test this theory, M. Lerebours took an ordinary daguerreotype plate of copper plated with silver, and on the copper back he engraved a crescent, and then polished the plate. Looking directly on it and as carefully as possible, nothing is seen; but when the sun's rays were received on the plate and thrown on a screen, the form of the crescent was clearly defined in the reflected image, darker or lighter than the rest, according to the distance of the mirror from the screen.—*Cosmos, 5th August*, 1853.

Photography on Stone. By MM. Barreswil and Lemercier.*

The process proposed by the authors consists in preparing a negative on paper, and then producing a positive picture on lithographic stone. The negative is obtained by any method, the most rapid being preferable. The positive is produced by a fatty or resinous coating laid on the stone, and capable of being rendered soluble in some solvent by the action of light (and perhaps of oxygen). The negative is laid upon the lithographic stone thus prepared, and covered with a glass plate; the whole is then exposed to the sun, the stone washed with the solvent, and then treated by the ordinary processes of lithography. The authors have hitherto employed asphaltum for coating the stone, and sulphuric ether as the solvent. They expect in this manner to reproduce engravings, lithographs, &c.—*Comptes Rendus*, May 16, 1853, p. 878.

An Enormous Cog-Wheel.†

Messrs. Randolph, Elder & Co., Engineers, of Glasgow, have just completed the largest cog-wheel ever made. It is intended to drive the screw propeller of one of the leviathan steamers now building by Messrs. Tod and M'Gregor. It has been found in practice preferable to have the propeller shaft driven at a velocity much greater than can be conveniently attained by the direct action of the engines, and hence the employment of a wheel and pinion to bring up the speed of the screw shaft to about three-fold that of the engines; and in order to deaden the jarring sound produced by metal wheels working together, the large wheel is fitted with wooden wheels or cogs, those of the pinon being iron. The result of this

* From the London Chemical Gazette, No. 258.

† From the London Civil Engineer and Architect's Journal, July, 1853.

combination is, a smoothness and noiselessness of motion hardly to be expected in such ponderous mechanism.

The cog-wheel at present being fitted up is 13½ feet in diameter, 5 feet 8 inches broad on the face, and weighs upwards of 30 tons. There are two sets of arms, of six each, firmly bolted to the inside of the periphery and to each other. There are four rows of cogs breaking joint, each row consisting of 110 teeth, formed of beech, nicely fitted into their sockets, and then shaped off to a shaving by a machine to their exact pitch and position. But perhaps a more popular idea of the enormous size and strength of this wheel will be conveyed by the fact, that the wooden teeth alone will weigh upwards of three tons. The entire ring is one piece, and must have been an extremely difficult piece of work to cast, as there are no less than 880 openings left through its circumference, and all accurate as to size and position, in which the wooden teeth have to be inserted and secured. The main shaft of the engine passes through the eye of this wheel, with a crank on each end placed at right angles. The pinion is one-third of the size of the driving wheel, with four rows of teeth also; but with the view of equalizing the wear, there is what millwrights call a hunting-cog, being one more than an aliquot part of the driver. Thus, in the present case there are thirty-seven teeth in each row, which is more than a third of the number in the large wheel. To fashion the teeth in a pinion with four rows of teeth all breaking joint, is a very nice problem indeed; and in the present case peculiar tools had to be made to meet the difficulty, so that the pinion is finished ready to gear without having a file or chisel upon one of the 148 teeth serrating its circumference. When the driving wheel weighs between 30 and 40 tons, what the engines will weigh is a natural inquiry; but we cannot answer the question at present, although we would suppose that they will be of the collective power of 800 horses, and will not, with the boilers, weigh less than probably 600 tons, a load of itself for a goodly sized ship. It is astonishing the progress that the screw propellers have made in public estimation. It is not more than six years since they can be said to have come into use, and already they are fast superseding the paddle. Indeed, the Peninsular and Oriental Steam Navigation Company have resolved upon building no more paddle steamers, being satisfied that the screw is more economical and handy in sea-going steamers.

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*Coating Iron with Copper.—Watts and Burgess' Patent.**

This patent has just been taken out for coating iron nails, sheets, and tubes, with copper or brass. As this is effected by fusion, none of the injurious consequences that take place when the coating is deposited by electrical agency can occur. A long series of trials have been conducted at Woolwich Dock Yard, in which iron bolts and deck nails coated with copper throughout their length, and having solid copper points fused to one or both ends, have been experimented upon. The copper ends are made sufficiently long to clinch. These tipped or compound bolts are quite a novelty in ship building, and possess all the advantages of solid copper bolts.

* From the London Mechanics' Magazine, August, 1852.

The experiments in Woolwich Yard, under the direction of Charles Atherton, Esq., Chief Engineer, commenced with trials to ascertain whether the coating process acted injuriously upon the iron. Bars of iron of various sizes were cut into equal lengths, and a certain number of each size were then coated. These were tested in the hydraulic machine with an equal number of the uncoated lengths; no difference in their strengths could be perceived. Other lengths were subjected to cold hammering, being bent double and beaten close, but the texture of the iron was not at all injured. Iron bolts with a solid end of copper, were then turned to exactly an inch in diameter and placed in the proving machine; in all cases the fracture took place in the solid copper, and not at the juncture of the two metals, which it was afterwards found impossible to sever with a strain equal to 21·6 tons to a square inch.

Deck nails were then driven into deal and African oak without injuring the heads, although in some instances no hole was bored to receive them. Two logs of African oak were bolted together with the pointed bolts, which were afterwards clinched in the usual way; the logs were then wedged asunder, the heads drawing through the solid wood. This experiment was repeated, a copper bolt being substituted for one of the compound bolts; when the logs were set apart the copper bolt drew through the rings, the other standing firm. The trials were pronounced highly satisfactory by the officers appointed to superintend them.

Is this the process patented in this country by Mr. Pomeroy, of Baltimore, and reported on in 25th Vol., p. 213, of this *Journal*? The results resemble each other very much. Mr. Pomeroy's patent dates from 9th July, 1849, although issued 8th January, 1850. ED.

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*Ingenious Mode of Ventilating Ships.**

The ship *Evangeline*, recently launched by Messrs. Jordan and Getty, has been fitted with iron masts, which are hollow cylinders, and which have been fitted with trap doors at either end, to open or shut at pleasure, for the ventilation of the ship. It has been found that a perfect ventilation can be accomplished by these masts, even when the ship is stationary, which is a desideratum in passenger ships seldom attained. The *Evangeline* has taken her departure for New Orleans, with goods and passengers, the latter being chiefly Germans. She belongs to Messrs. Clint & Co.—*Liverpool Times*.

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, September 15, 1853.

John E. Addicks, Esq., President, P. T., in the chair.
John F. Frazer, Treasurer.
Isaac B. Garrigues, Recording Secretary.

* From the London Railway and Commercial Gazette, No. 924.

The minutes of the last meeting were read and approved.

Donations to the Library were received from Edward Hinckley, Esq., Baltimore, Maryland, and Professor John F. Frazer, Philadelphia.

The Periodicals received in exchange for the Journal of the Institute were laid on the table.

The Treasurer read his statement for August.

The Board of Managers and Standing Committees reported their minutes.

New candidates for membership in the Institute (11) were proposed, and the candidates (9) proposed at the last meeting were duly elected.

Dr. Rand, Chairman of the Committee on Meetings, brought before the meeting, Echols' Water Gauge for Steam Boilers. It consists of a metal cylinder of about 2½ inches diameter, attached to the boiler by two smaller tubes, provided with stop-cocks, one entering above and the other below the water line. Midway of the vertical height of the cylinder are two openings, opposite each other, in which are screwed hollow nuts, the inner openings in which nuts are closed by hemispheres of glass, the convex portion inwards; between these rises and falls a graduated rod attached to a float, the numbers on the rod being visible as they come opposite the openings.

The stop-cock at the lower end of the gauge is a three way cock, and may be thus made to cut off communication with the water in the boiler, and open a small vent tube, leading externally, by which means all the water in the gauge may be blown out in case of any obstruction. The height of the water in the gauge may also, if desired, be tested by thus blowing out the water, measuring its amount, and calculating its height, for the known capacity of the cylinder.

This invention is at present under consideration by the Committee on Science and the Arts.

Dr. Rand also exhibited a model of a Turn-Table, or Anti-Friction Box, patented by George T. Parry, of this city. In it the rollers are of the shape of double frustra of cones, reversed, and united at their bases, revolving in circular grooves of nearly corresponding form.

This invention is also, at present, under consideration by the Committee on Science and the Arts.

Dr. Rand further presented Kidders' Gas Regulator, designed to be attached between the service pipe and meter in buildings, for the purpose of preventing the fluctuations in the light, due to the unavoidable variations of pressure in the street mains. It consists of a small telescopic gas holder sealed with mercury. The upper section carries a rod, to the lower portion of which is a conical valve, apex upwards, which fits into a corresponding socket in the lower opening, or that for the entrance of the gas, which, as it rises with the upper section of the gas holder under an increase of pressure, controls the supply, and, consequently, the pressure. The apparatus resembles the governor used at the gas works to control the supply of gas from the gas holders to the street mains; the latter, however, is sealed with water.

Dr. Rand also presented Whitney's Inkstand. An ordinary glass inkstand is made entire, with the exception of two openings in its upper sur-

face. One of these is covered by an elastic diaphragm, regulated by a screw; into the other fits air tight, a small glass funnel, the neck of which reaches nearly to the bottom. By compressing the air above the level of the ink by means of the screw, the ink rises up into the cone of the funnel. The whole fits into a neat frame supporting a rack for pens, &c.

Mr. Nathan Atherton exhibited a model of a method of converting reciprocating into rotary motion, and gave the following description of it.

The nature of my invention consists in applying a cylinder with a right and left continuous groove, (forming a double inclined plane or screw,) the pitch and diameter of which is in proportion to the length of the stroke of the piston.

If for a steam engine, for example, then, according to the length of the stroke of the reciprocating motion to which it shall be applied, I construct my cylinder, called the impulse cylinder, by having cast or cut in its surface a groove, starting at a point near one end of the cylinder, and continuing around the cylinder to a point on the opposite side from the starting point, and near the other end of the cylinder from the starting point; and from this second point I continue the groove around the cylinder, returning to the starting point; thus making a continuous groove, and forming a double inclined plane.

I apply this cylinder, properly housed, so that it may revolve on its shaft. A friction wheel is attached to the cross-head, and works in the groove of the impulse cylinder. The cross-head, upon being propelled forward, causes the cylinder to make a half revolution, and upon the cross-head being returned down the groove of the other side of the cylinder to its first position, will complete the full revolution of the cylinder upon the shaft.

Mr. McRea exhibited to the meeting, his Railroad-Drawbridge, and Switch Safety Telegraph, which was described by Prof. Frazer. The object of this apparatus is, to give to the conductor of a railroad train, when approaching a drawbridge or switch, a signal by which he may know that the bridge or switch is in the right position to pass the train with safety. To accomplish this, an electric current is established from a battery, including in it, the drawbridge or switch, so that if these be in proper position, the circuit is complete at that point, but that if they be out of position, the circuit is there broken. The zinc which forms the conductor, terminates at a safe distance from the bridge or switch, in a carefully insulated rail, and the next rail, also carefully insulated, is connected with a ground plate, by which the circuit is completed. An ordinary electro-magnet is placed upon the locomotive, its armature so adjusted as to control the sounding works of an alarm; and the extremities of its coils terminating, the one on the front, the other on the hind axle of the locomotive. Then it is evident that the electric circuit is broken at the insulated rails, but that when the locomotive reaches that point, the front wheels being on one, while the hind wheels are on the other insulated rail, the circuit will be completed, and the bell sound, provided the drawbridge or switch be in proper position, but that if they should

not be so, then the bell cannot sound, for the armature will not be attracted, in consequence of the circuit being broken at the bridge or switch. It will be observed here that the indication to the conductor that he may proceed is given by an actual, audible signal, and that this signal cannot be given by any accident. The only effect of the apparatus getting out of order or not working, is to make the conductor proceed cautiously. It will also be seen that if it be found necessary in practice, the insulated rails in which the parts of the circuit terminate may be separate from the track, and placed inside or outside of it, the connexion with the engine being made by metallic springs at its front and back, projecting downwards so as to press upon them.

Mr. McRea also proposed a modification of the above apparatus to prevent collisions on single tracks. In this case, a double circuit is established from the same battery to the turn-out, at the extremities of the part of the track on which the trains may meet. The lines here terminate by circuit-changers, by which all current is stopped, while the apparatus is not in use. The conductor who first arrives at either end of this prepared track, shifts the changer, by which means he establishes the circuit from the other end through his magnet, and if everything is right, gets the signal that he may go on, leaving the changer as he placed it. Then when the other train arrives at the opposite end, he cannot complete a circuit, because his circuit must come from the other end, and has been already broken by the first conductor; he therefore knows that the other train has passed the next turn out, and must wait until it passes him. Each conductor, as he passes off the prepared track, places the circuit changer of that end in its first position, and the apparatus is ready for service again. It will be seen that these changes may be easily done, if desirable, mechanically by the engines themselves. And here, again, the derangement of the apparatus can only result in additional caution on the part of those in charge.

G. W. Smith, Esq., briefly explained to the meeting the theory of stammering, and some of the methods which had been resorted to for curing it; he introduced to the meeting Mr. Robert Bates, of Philadelphia, who formerly had labored under this disability, and had, by mechanical means of his own invention, effected a radical cure of himself, which he manifested to the satisfaction of the meeting. The method consists in the employment of a tube for the passage of air from the mouth, when the muscles that close the orifice and stop the egress of air in speaking, are suddenly contracted by spasmodic action, and the employment of a strap around the throat provided with a spring pad (regulated by a screw,) pressing against the throat, keeping the glottis or larynx open; thereby allowing a free passage through the throat and mouth from the lungs, the arrest of which causes stammering. The tube is shaped to fit the roof of the mouth, is flattened and open at each end, is about $\frac{7}{8}$ths of an inch long, $\frac{3}{8} \times \frac{1}{16}$ extending down to the teeth, where it can be fastened by passing a small wire between them; the lingual or dental sounds are thus made; the labial sounds are made by an additional extension of the tubes beyond the lips; the guttural sounds are accomplished by the pressure of the pad. By constant use of these instruments for a short time the correction of a bad habit is effected, and the tube is gradually con-

tracted, and the spring of the pad eased, until a continuance of them is no longer necessary.

Mr. Smith exhibited a large drawing of the spire and tower of the Baptist Church at the corner of Brown and Broad streets, designed and drawn by Mr. J. E. Carver, architect; the total height, 187 feet; the spire is of open work, richly adorned with pinnacles, crockets, and tabernacle work, and will be the richest example in the United States, and will have some general resemblance to the spire of Ulm Minster, as originally designed, although greatly inferior to it in magnitude and luxuriance of adornment. The entasis will be about five inches. Mr. S. proceeded to compare this spire with others existing in Philadelphia, and other places in the United States and Europe, and comparing their relative merits and characters. The design of Mr. Carver appeared to elicit the approbation of the members present.

Mr. S. exhibited some very beautiful crystalotypes, and some made by the collodion process in the establishment of Messrs. M'Clees & Germon, Philadelphia, as well as some by Mr. Whipple, of Boston, Mass.; among them, one attracted much attention, viz: a representation of the moon, drawn by herself, by means of the great equatorial telescope at Cambridge, Mass. A peculiarity in the delineation attracted much attention, the cause of which was not satisfactorily solved, viz: the apparent transparency of the shadows of the unilluminated sides of the various craters.

BIBLIOGRAPHICAL NOTICE.

Tables of the Prime Numbers and Prime Factors of Composite Numbers, from 1 *to* 100,000, *with the Methods of their Construction, and Examples of their Use.* By Edward Hinkley, A. M. Baltimore. Printed for the Author: 1853. 8 vo. pp. 216.

This work will prove valuable to all who take an interest in the study of the properties of numbers, and those who are compelled to perform elaborate calculations involving them. The rapidity and simplification of the operations of multiplication and division upon large numbers, by resolving these into their prime factors, and eliminating such as are common, can scarcely be conceived, except by those who have rendered themselves familiar with the process. The tables contained in the work before us are copious and well arranged for reference, and the explanations and examples in illustration of them generally clear and sufficient.

As a scientific treatise, it is deficient in form. It used to be said of a certain book-writer, that he wrote his works for the purpose of studying the subject; and the curious *ex post facto* way in which much of the information as to the labors of others in the same branch is conveyed, would lead to the not improbable supposition that something of the same kind had been the case here. We hope a second edition will be wanted before long, and if so, that the author will put such excellent material in a more perfect form.

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PROMOTION OF THE MECHANIC ARTS.

NOVEMBER, 1853.

CIVIL ENGINEERING.

On Railway Axle Lubrication. By Mr. W. Bridges Adams, of London.*

In the economy of railway transit an idea has prevailed that increase of speed increases cost in a compound proportion, in many other things than the mere excess of fuel consumed in the locomotive. This is correct only in reference to imperfect appliances. If, for example, the rails deflect beneath the rolling loads, the substructure will be displaced, and increased speed will greatly increase the displacement. If the wheel peripheries be out of order, the greater the speed the greater will be the destruction; and so also, if the rail surfaces or joints be out of order. And in proportion as the springs are inefficient, *i. e.*, are non-elastic, or do not act through sufficient space to moderate the shocks, so will the destructive wear be increased by increased speed. But were all parts of the system—ballast, sleepers, rails, wheels, axles, journals, bearings, lubrication, and springs—rendered as perfect as is within the scope of mechanical art, there seems to be no reason why increased speed should involve any extra cost beyond the increased consumption of fuel, oil, and grease, provided all parts of the system be proportioned to each other.

In increasing speed with imperfect mechanical arrangements, one of the most prominent difficulties occurs in preventing axles and axle boxes from heating; the cause of the heating is in the imperfect lubrication. The word lubrication literally signifies slipperiness, but this does not express the precise action. Oil, or grease, or soap, interposed between two metallic bodies moving one upon the other, is composed of a series of small globules, which keep the bodies separated, and serve as rollers.

* From the London Artizan, July, 1853.

The surfaces of metallic bodies, however apparently smooth, are composed of salient and re-entrant angles of larger or smaller size, according as the metal is hard and polished, or soft and rough. Therefore the more imperfect the structure of an axle and bearing, the more viscid must be the lubricating material to keep them from contact. If the cushion of lubricating material be insufficient in extent, contact ensues between the salient angles of the metal, and heating takes place to such an extent as to boil away the lubricating material and drive it off.

In calculating the surface bearing of axles, there are two circumstances to consider:—First, actual weight to be borne; and, secondly, the amount of concussion adding to the effect of the weight, which latter will much depend on the efficiency of the springs to moderate the effect of the shock.

Before the advent of railways, mail coaches and private carriages, with a maximum weight of three tons, were constructed with axles case-hardened, and with a bearing surface on each arm equivalent to thirty square inches. This is equivalent to about 56 pounds per square inch on the bearing.

Mr. Nicholas Wood, in his experiments on axle friction, found that, with the best oil and with favorable circumstances, a superincumbent weight of 90 lbs. per square inch gave the minimum of friction.

Some of the earliest railway axle bearings were 4 inches in length by 2¼ in diameter, something under 14 inches of total bearing surface, fitted according to Mr. Wood's calculations, only for a wagon of two tons total weight. It would seem as though these sizes had been calculated from the fixed shafting of factories, without any calculation of concussion. Probably this was the reason why viscid soap was substituted for fluid oil, increasing the toughness of the material used for lubrication to make up for the want of bearing surface. In railway practice it is found that the soap or grease which serves well in the winter is too fluid in the summer, a sure proof that the bearing surface is far too small for any lubrication with oil, which offers the minimum amount of friction. A strong objection to soap lubrication is, that it requires considerable amount of friction in the winter time to make it fluid; and it is sometimes difficult to start a train into motion when the grease has been frozen.

In the wheels of highway carriages the oil chambers are contained within the wheels, and revolve with them, which process involves the efficient lubrication of the axle. In the axle boxes of railway carriages the grease or oil does not revolve. In the highway wheels, the oil always has a tendency to rest in the well or magazine below the level of the axle. In the ordinary axle boxes of railway carriages the grease or oil is above the level of the axle, and, as the axle revolves, the oil or grease, or rather the grease (oil not being used, except in engines), passes through a hole or holes in the bearing brass, which lies on the upper half of the axle; and thus the process is like that of a handmill, the lubricating material is supplied on the upper surface of the axle, and passes away at the lower like grist. To make the lubrication more certain, the holes are of large size; and this involves an evil by diminishing the bearing surface at the most important point. If these holes get stopped, the lubrication ceases and heating ensues; and there are no means to remedy the evil, save by lifting the bearing from the axle and inserting more grease.

Thus, in the ordinary railway grease box, there is not only a great waste of grease, but also a very imperfect mode of securing lubrication. The well made, case hardened axles of a common road carriage are capable of running 5000 miles over a bad road with once oiling with a small quantity of oil, while railway axles require greasing every 100 miles or less, with some few exceptions.

Impressed with these imperfections, the writer some years back began to consider the best means of remedying them. It was evident that the only mode of applying grease or oil to a large surface of the axle bearing was at the under side. In the common mode of an open bottom this was scarcely practicable; and the question was, could the bottom be effectually closed without so confining the axle as to make partial heating dangerous. This was accomplished by applying a flexible connexion between the axle and the inner side of the axle box, and making the bottom of the box tight. In this mode, the grease filling the lower part of the box, the whole under surface of the axle was bathed in it, while all dirt and grit were excluded. Moreover, the grease being as it were in a well below the axle, any accidental extraneous matters could sink to the bottom, and not be brought in contact with the wearing surface. And, supposing the upper holes to be entirely stopped, lubrication would go on notwithstanding. It must be evident that feeding from above in all cases involves the chance of dirt getting to the axle, which feeding from below obviates.

To provide against accidental injury to the axle bearings, the writer provided also for a mode of shrinking on a false bearing upon the axle arm; so that, in case of cutting, it might be removed and replaced. The following is a description of the axle box invented and patented by the writer, in May, 1847, which is shown in the accompanying drawings:—

Fig. 1.

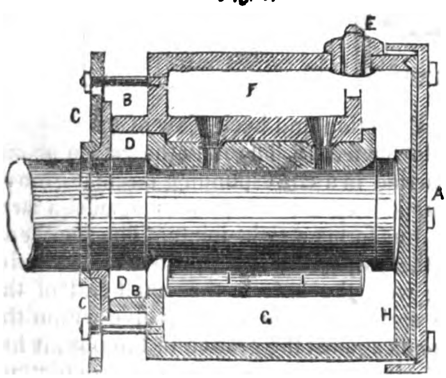


Fig. 2.

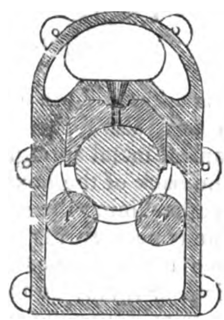


Fig. 1 is a longitudinal section, and fig. 2 a transverse section, of the axle boxes employed on the North Kent line. The top of the box is circular, for a peculiar arrangement of springs; the box is cast open-fronted, with a movable front, A, to attach by screws, a grease-tight joint being maintained by an elastic substance between. In this mode the interior of the box can be inspected, and a new brass applied, without lifting the carriage. The back of the box round the axle is cast with a

round edged projecting lip, B B. A plate of metal, C C, with a centre hole fitting the axle, is secured by bolts to the back of the box, with a piece of leather, D D, the orifice of which is enlarged into a partial pipe form round the axle, to give increased bearing surface. This leather presses equally on the axle and on the lip of the box, and thus a tight joint is maintained, which preserves the grease without overflowing above the level of the bottom of the axle. The bolt holes in the metal plate are oblong vertically, so that when the upper bearing brass wears and causes a corresponding wear in the plate and leather, and a consequent leak below, the two latter may be drawn upward to fit the lower part of the axle. At the top of the box there is a screw tap, E, for feeding, with holes through it, to admit the ingress and egress of air. This tap serves to feed an upper chamber, F, with holes to the axle as usual, and also to feed the lower chamber, G, which, in addition, catches the grease that falls through from the upper chamber by the working of the axle. A piece of hard wood, H, is applied between the end of the axle and the front of the box, to prevent wear of the shoulder-collar of the bearing brass. Two rollers of light wood, I I, float on the oil or grease in contact with the lower side of the axle, and thus carry up the lubricating material, if it happens to be below the level of the axle.

Fig. 3.

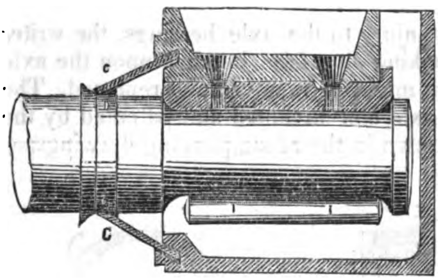
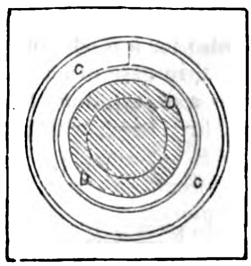


Fig. 4.



Figs. 3 and 4 are a longitudinal section and back view of an axle and axle box, also for an upper and lower feed. To retain the grease or oil, a conical metal spring, C C, is inserted in a corresponding circular groove at the back of the box; by its elastic expansion it presses against a strip of leather lining the groove, and thus forms a tight joint. The small end of the conical spring clips a leather pipe-collar, D D, fitted on the axle, which collar may either revolve with the axle in the small end of the spring, or it may be fixed to the spring, and the axle revolve within the leather collar; as the spring expands against the groove in the box, it has no tendency to press the axle or leather too tightly, so as to cause friction. The conical spring is prevented from turning by a stud; the edges of the spring overlap each other, to keep out dirt; and the hollow space between the spring and the axle may be filled with sponge or cotton waste.

Figs. 5 and 6 show a longitudinal section and back view of an axle box on a similar arrangement, in which a conical pipe of blocked leather, C C, is secured to the box lip by an elastic ring, D D, similar to a key ring, and clipped to the axle by a second ring, E E. Both the spring cone

and the leather cone will, by their free action, accommodate any irregular movement of the box, and prevent loose wear between both the metal plate and leather. In all cases where any material comes in contact with the revolving axle, it is essential that the surface be properly smoothed, that the pressure be as light as may be convenient, and the lubrication certain.

Fig. 5.

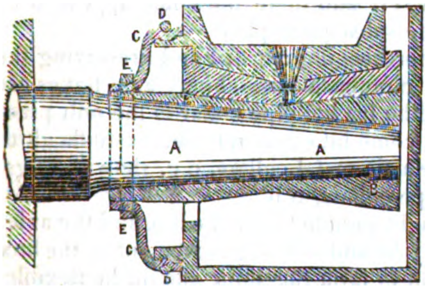


Fig. 6.

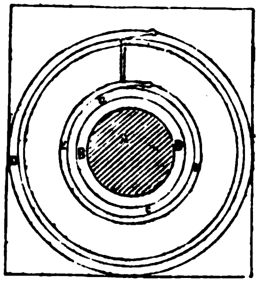


Fig 5, in addition to the axle box arrangement, shows a mode of applying movable journals to axle arms, either new or old. Thus, the journal, A A, may be forged down to a taper, with the object of extending the distance of the bearing from the wheel, or of increasing the diameter of the axle bearing. The movable bearing, B B, may be of wrought iron, or cast iron well got up and case-hardened; and manufacturers might be enabled to supply a superior class of axle box and bearing cheaply. Railway companies might thus be enabled, at comparatively little cost, to replace their axles, when rendered unsafe by long vibration in running. The hollow axle, shown at figs. 7 and 8, would be well adapted to this arrangement.

Fig. 7.

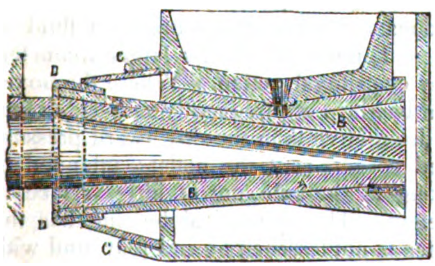
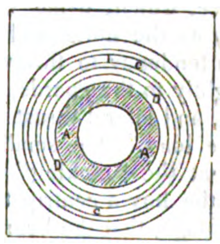


Fig. 8.



Great numbers of these boxes, with leather collars, have been applied, and have been found to answer the desired purpose.

It should be remarked, that it is desirable, in all cases, to get the axle bearings as long as is convenient, even when not required for bearing surface, for the following reasons:—The points of the springs which support the frames are at a considerable elevation above the axle bearing, and act with mischievous leverage to tilt the axle boxes laterally to the carriage, when the wheel flanches strike the rail. It is evident that, unless there be some proportion in the length of bearing to the height of

the spring, there will be a great strain upon the guards of the axle boxes to keep them steady.

The axle box described above is the first application of the principle of retaining the grease or oil, by closing in the back of the box.

Since the above described, similar contrivances have been brought out by various other parties, for the purpose of retaining the grease in the axle boxes; but it appears that the original application of the principle was that of the writer, in May, 1847; and there does not appear to be any material variation in any of the subsequent plans.

As to the practical mechanism for keeping out dirt and preserving the bath of grease, it must vary with circumstances. Many axle boxes are so close to the wheel bosses, that the leather pipe collar is the only practicable arrangement; and, having come into general use, it is difficult to vary, but the writer prefers the elastic metal collars, C C, shown in figs. 3 and 7, pressing upon leather pipe collars, D D.

The object sought is to form a tight joint between the box and the axle, which are both exposed to rough jolts and a tilting movement of the box on the axle; therefore the medium to form the joint should be flexible, and not liable to be put out of order.

The mode of lubrication from above the bearing has one objection, in the liability to accident by dirt getting on the arm, and from the holes wasting a most important part of the bearing surface; but the writer thinks it preferable to retain it, keeping the holes small, but merely as a security in case of any accident happening to the lower reservoir.

Two forms of journal are shown in the diagrams; one the double cone, figs. 5 and 7, the other the ordinary cylindrical journal with collars, figs. 1 and 3. There is an advantage in the double cone with the small diameter in the centre of the bearing, that it has a tendency to cause the lubricating fluid to press outwards from the centre while in rapid motion. The cylindrical bearing between collars has also this disadvantage, that the box is not kept in its position by gravity, but by a very small collar surface, which, being vertical, does not retain the lubricating fluid so easily as the horizontal surface; and, moreover, by its larger diameter, has a tendency to throw it off by centrifugal action. Where the boxes fit tightly to the guards, the collar bearings are frequently subject to rapid wear, and lateral thrust is more destructive than the downward pressure of the load. The small rounded corners next the collars, intended to prevent the "nicking" or breaking of the axle, are of little service to give the box a centripetal tendency. The cylindrical bearing has the advantage, that the bearing surface is not lessened by end play, and with the axle working in a bath of lubricating material, the collars will at all times be safe enough. In either case, of the cone or the cylinder, it is clear that the lubricating bath below will be the safest precaution against heating. As regards the strength of the axle, the cone journal has the advantage, by its gradual tapering form, supposing an equal amount of metal in both cases. The fitting of the wearing brass to the journal is a matter of greater nicety with the cone than with the cylinder; with cylindrical journals the usual practice is to make the bearing brass of considerably larger radius than the journal, so that it bears on a very small surface, which wears to a polish, and gradually extends to the half dia-

meter. In point of fact, railway bearings are made to grind themselves to a true fit to work, instead of being accurately ground and fitted beforehand, as in the case wi h nicer machinery.

The Chairman inquired what comparative results were obtained as to consumption of grease in the axle boxes tried on the North Kent line.

Mr. W. B. Adams said he understood that the axle boxes worked very satisfactorily, and with a reduced consumption of grease; but he was not able to give the results of the economy, as an exact comparison had not been made.

The Chairman observed that there appeared some difficulty in the conical spring proposed, for the purpose of making a close joint between the box and axle, and inquired whether it had been found to have sufficient elasticity to work well.

Mr. W. B. Adams said that the only plan which had been practically tried was the leather collar first described; he had not yet applied the conical spring, because there was not, in many cases, space enough to get it in between the axle box and the nave of the wheel, and therefore the leather collar only had been used, which had the advantage of taking up less space; but he thought the conical spring was preferable, and would make the most perfect joint, and there would be no difficulty in adopting it in modern carriages, as the projection of the axle from the wheel is now commonly extended to increase the width of the bearing.

The Chairman inquired how the grit was found to be kept out in Mr. Allan's sponge axle box, that was described at the last meeting.

Mr. Allan said that his axle box was designed for using oil, instead of grease; and the only way dust and grit was kept out was the proximity of the nave of the wheel to the face of the axle box, but it was found that the sponge prevented the grit from penetrating more than a short distance, about an inch or an inch and a half along the journal, as shown by the sponges, when taken out.

Mr. E. A. Cowper remarked, that it was an important desideratum to get a grease-tight joint at the back of the axie box, that would effectually keep out the grit, and not be interfered with by wear and motion of the box; and he thought that such a joint had yet to be accomplished. In the American axle box, described at a recent meeting, the leather flanch worked in a groove on the axle; it appeared a simple means for attaining this object, but some elastic provision for following up the wear was also wanted; this was proposed to be effected by the conical spring, though that plan might admit of further improvements, as there was generally very little room between the wheel and the axle box.

Mr. W. B. Adams thought that some good plan was certainly much wanted, for efficiently closing the back of the axle box, and there was not such a one in use at present; he thought the three or four inches space now usually left between the nave and axle box would be sufficient for the introduction of the proposed conical spring.

The Chairman observed that it was a very important point to get the grit thoroughly shut out, and a good combination might perhaps be made of some of the plans that had been proposed for the purpose; any experiments on lubrication were interfered with in the results by the entrance of grit.

Mr. W. B. Adams remarked the difficulty of making exactly parallel experiments on the lubrication of railway axles, from the number of disturbing circumstances, in the variation of weight and uniformity of bearing on the journals, and in the attention to the lubrication, and the difficulty of getting the exact mileage.

Mr. Lea suggested the experiments to be made at the same time on opposite sides of the same carriage, so as to have them under similar circumstances.

The Chairman said he hoped Mr. Adams would pursue the subject, and give them further results; and he proposed a vote of thanks to him for his paper, which was passed.

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*American Legislation for Railways.**

The following appears in an American paper:—

"*Hartford, June* 9.—The committee on railroads have reported to the Legislature of Connecticut a bill which provides that all trains shall come to a full stop at all drawbridges, and wherever the track crosses that of other roads. It attaches heavy penalties for every instance of these regulations being disregarded. The engineers are to be fined and imprisoned, and the President or Directors being parties thereto shall be fined $1000. It also requires men to be stationed at all the switches under similar penalties, and where the speed is over 30 miles per hour a brakesman is required for every car, under a penalty of $1000. Engineers neglecting to stop the train when persons are seen upon the track are to be deemed guilty of manslaughter, if such persons are killed. The Presidents of all roads within the State must reside within its boundaries, and the officers of roads out of the State are not to be allowed to hold any offices upon roads in the State, under a penalty of $1000 per day."

In the state of Illinois a fine of $5000 or £1000 is imposed for every death caused by a railway.

Such regulations may do for America, but would by no means suit England. We do not say this with respect to the fines and imprisonments on the engine driver in case of accidents through disobedience of orders or carelessness, nor to the fining of Directors when parties thereto, nor to fining officers for holding situations on more lines than one; but to make trains come to rest at all crossings of other roads and when persons are seen on the line, would in England be preposterous. They would hardly ever get to the end of the journey on some railways in the north; and as to express trains, it would put an extinguisher on them at once. Again, to stick a man at every switch all day long is nonsense. The fellow would fall asleep if he had not something else to do. A brakesman to every carriage when the speed exceeds 30 miles an hour shows two things, the little knowledge the framers of the bill must have of railways, and the comparatively slow speed at which the American trains travel. If they were to go like some of our express trains at 60 miles an hour, we presume they would have two or three brakesmen at every carriage, and possibly one for every wheel.

*From Herapath's Journal, No. 734.

For the Journal of the Franklin Institute.

Experiments on Screw Propellers in H. B. M. Steamer Minx. By B. F. Isherwood, Chief Eng., U. S. N.

(Continued from page 226.)

Screws of Expanding Pitch Fore and Aft, but of Uniform Pitch Radially.

Two screws were experimented with, having their pitches expanding from fore to aft, but uniform radially. They were two-bladed screws of 4 feet 6 inches diameter, and 12 inches length. Their mean pitches were designed to be respectively 5 feet, and 5 feet 6 inches. With the screw having the mean pitch of 5 feet 6 inches two experiments were made, which were so greatly inconsistent with the general results that I reject them.

With the screw of 5 feet mean pitch, which I shall call screw D, three trials were made, giving results closely agreeing with each other and consistent with the general results; I therefore accept them. The initial pitch of this screw was 4 feet 10 inches; the final pitch, 5 feet 2 inches; the rate of expansion being 7 per centum of the initial pitch. The mean pitch being 5 feet, this screw was in all respects the same as screw C, of the series of uniform pitch.

The slip of screw C was 31·6 per centum; that of screw D (calculated for the mean pitch of 5 feet, same as for screw C,) was 26·2 per centum, showing a reduction in the slip of 5·4 per centum absolutely, or $\left(\frac{31{\cdot}6 - 26{\cdot}2 \times 100}{31{\cdot}6} = \right)$ 17·1 per centum relatively, by the employment of the expanding pitch. With screw C, a speed of 8·576 geographical miles per hour was obtained with 205·56 horses power. With screw D, a speed of 8·615 geographical miles per hour was obtained with 193·34 horses power. The relative economical efficiencies of the two screws will therefore be as follows:

	Powers.	Speeds.	Effects.	Relative economical efficiencies.
Screw C.	205·56 or 1·0000—	8·576 or 1·0000 and	$1{\cdot}0000^3 = 1{\cdot}0000$ and	$\frac{1{\cdot}0000}{1{\cdot}0000} = 1{\cdot}0000.$
Screw D.	193·34 or 0·9405—	8·615 or 1·0045 and	$1{\cdot}0045^3 = 1{\cdot}0136$ and	$\frac{1{\cdot}0136}{0{\cdot}9405} = 1{\cdot}0777.$

Whence appears, that in the cases of the two screws, having equal diameters, number of blades, and surfaces, the uniform pitch of one and the mean of the expanding pitch of the other being the same, the power was 1·0777 times better applied by the screw with the expanding pitch than by the screw with the uniform pitch. With the screw of expanding pitch a reduced slip of 5·40 per centum, (calculated for the mean pitch,) gave an increased efficiency of 7·77 per centum, and as the screw surface was equal in the two cases, the superiority must have arisen from the difference in the slip.

To further illustrate the effect of the expanding pitch, screw D was reversed on its shaft, and a trial made. By this reversal, the screw was

changed end for end, the greater pitch becoming the initial one, and the lesser pitch the final one. The slip, calculated for the same mean pitch (5 feet) as before, was now 39·9 per centum, or $(39\cdot9 - 26\cdot2 =)$ 13·7 per centum absolutely more than before, or $\left(\frac{39\cdot9 - 26\cdot2 \times 100}{26\cdot2} =\right)$ 52·7 per centum relatively more than before. In this condition of things, a speed of 6·628 geographical miles per hour was obtained with 148·94 horses power. With screw D, or this screw in its normal position, a speed of 8·615 geographical miles per hour was obtained with 193·34 horses power. The relative economical efficiency of the screw in the two positions will therefore be as follows:

Normal Position.

	Powers.	Speeds.	Effects.	Relative economical efficiencies.
Screw D.	193·34 or 1·2981	8·615 or 1·3004	and $1\cdot3004^3 = 2\cdot1990$	and $\frac{2\cdot1990}{1\cdot2981} = 1\cdot6940$.

Reversed Position.

Screw D.	148·94 or 1·0000	6·625 or 1·0000	and $1\cdot0000^3 = 1\cdot0000$	and $\frac{1\cdot0000}{1\cdot0000} = 1\cdot0000$.

Whence appears that the power was 69·4 per centum better applied by the screw in its normal than in its reversed position.

The following table exhibits in detail, the data and results of the screw D, with expanding pitch fore and aft, but uniform pitch radially:

	Vessel's draft of water in ft. and in.			SCREW.												ENGINES.			
					Vessels draft of water in ft. and inches.							Slips of the screws in per cents. of its speed.						
	Forward.	Aft.	Mean.	Diameter in ft. and ins.	Initial.	Mean.	Final.	Number of blades.	Helicoidal area in square feet.	Length in direction of axis in inches.	Number of revolutions made per minute.	Of initial pitch.	Of mean pitch.	Of final pitch.	Gross average pressures in the cylinders in lbs. per square inch.	Number of double strokes of engines' pistons made per minute.	Horses power developed by the engines.	Speed of the vessel per hour in knots of 6086⅔ feet.
									Screw D.									
*	4 6½	5 10½	....	4 6	4 10	5 0	5 2	2	7·2	12	217·2	22·1	24·7	27·1	9·52	54·29	....	8·069
†	4 5	6 1	....	4 6	4 10	5 0	5 2	2	7·2	12	254·1	24·6	27·1	29·4	12·19	63·53	....	9·137
‡	4 5	6 0	....	4 6	4 10	5 0	5 2	2	7·2	12	238·5	24·0	26·6	28·9	10·71	59·63	....	8·640
§	4 5½	5 11 7/[illegible]	5 2⅔	4 6	4 10	5 0	5 2	2	7·2	12	236·6	23·7	26·2	28·6	10·8	59·15	193·34	8·615
									Screw D, reversed.									
‖	4 6½	5 10½	5 2½	4 6	5 2	5 0	4 10	2	7·2	12	223·4	41·8	39·9	37·8	8·81	56·86	148·94	6·625

* July 8th, 1847. † July 1st, 1848. ‡ July 12th, 1848. § Means. ‖ August 17th, 1847.

Screws of Expanding Pitch Radially, but of Uniform Pitch Fore and Aft.—Three screws were tried, having their pitches uniform fore and aft, but expanding radially; that is, from the hub to the periphery. These screws were 4 feet 6 inches diameter, two-bladed, and 12 inches long, being similar screws in all other respects than pitch to those previously discussed. One of these screws having a pitch of 4 feet at the hub, and 5 feet at the periphery, was tried twice; once August 11th, and again September 18th, 1847, but the results are so inconsistent that I reject them. The remaining two screws I shall call respectively E and F.

With screw E two trials were made, and as the results closely agree, and are consistent with the general results, I accept them. This screw had a pitch of 4 feet 10 inches at the hub, and 5 feet 4 inches at the periphery, the rate of expansion being 10·3 per centum of the pitch at the hub. As the exact configuration of the screw is not given, the mean pitch cannot be *exactly* determined, but it is approximately 5·10 feet in function of surface, and of the square of the circumferential velocity of the surface: this determination I believe to be more than sufficiently accurate for practical results. It will be observed that screw E almost exactly corresponds to screw C, of the screws with uniform pitches, having the same diameter, number of blades, length and surface, and differing but slightly in its mean pitch, which is 5·10 feet, from the uniform pitch of screw C, which is 5 feet. The two screws may, therefore, be considered identical. With screw C, the slip was 31·6 per centum; with screw F, the slip was also 31.6 per centum, exactly the same, and showing that a screw with the pitch expanding radially from hub to periphery, produces the same result as a true screw, or screw of uniform pitch, when the diameter, number of blades, surface and *mean* pitch were the same with the one, as the diameter, number of blades, surface and uniform pitch with the other.

With screw F, three trials were made, and as the results closely agree with each other, and are consistent with the general results, I accept them. This screw had a pitch at the hub of 4 feet 3 inches, and at the periphery, of 6 feet 3 inches, being a rate of expansion of 47 per cent. over the pitch at the hub. The mean pitch, as approximately but closely determined, is 5·80 feet. It will be observed that this screw, F, almost exactly corresponds to screw A of the series with uniform pitch, having the same diameter, number of blades, length and surface, and differing but very slightly in its mean pitch, which is 5·80 feet, from the uniform pitch of A, which is 5·83 feet. The two screws may, therefore, be considered as identical. With screw A, the slip was 37·3 per centum; with screw F, the slip was 36·9 per centum, differing but four-tenths of one per centum. The result in this case verifies the proposition in the preceding paragraph, that equal results are produced by screws of equal diameter, number of blades, length and surface, and differing but in the nature of the pitch, which in the one is uniform, and in the other expanding radially, but having the mean pitch of the latter equal to the uniform pitch of the former.

In proceeding to ascertain the relative economical efficiency of screws E and F, comparatively to screws C and A, by taking the horses power developed by the engines in the several cases, for the measure of the power exerted, and the cubes of the vessel's speed for the measure of the effects produced, it is necessary to make a correction of what is given as the indicated gross pressure in the cylinders in the case of screw E, which pressure is obviously greatly incorrect. In the two trials with that screw, this pressure is respectively 9·42 and 9·41 pounds per square inch, mean 9·415 pounds, for 53·40 and 56·71 double strokes of engines' pistons, mean 55·06 double strokes; while for screw C, the average gross pressure in the cylinders is 10·7 pounds per square inch, with 63·48 double strokes of pistons. These latter numbers being consistent with the gene-

ral results throughout the experiments, are taken to be correct, and as with the same screw propelling the same vessel under the same conditions, the piston pressures will be in the proportion of the squares of the number of double strokes of piston made in equal times; the piston pressure in the case of screw B, will be $(63{\cdot}48^2 : 10{\cdot}7_{\cdot} :: 55{\cdot}06^2 : 8{\cdot}051)$ 8·051 pounds per square inch, which increased in the ratio of 5·1 to 5·0 for the different pitches becomes 8·212 pounds; this number is, therefore, substituted for the pressure, 9·415 pounds, and the horses power calculated from it. With this correction the relative economical efficiency of the screws will compare as follows:

	Powers.	Speeds.	Effects.	Relative economical efficiencies.
Screw E.	136·84 or 1·0000—	7·575 or 1·0000 and	$1{\cdot}0000^3 = 1{\cdot}0000$ and	$\frac{1{\cdot}0000}{1{\cdot}0000} = 1{\cdot}0000.$
" C.	205·56 or 1·5022—	8·576 or 1·1321 and	$1{\cdot}1321^3 = 1{\cdot}4510$ and	$\frac{1{\cdot}4510}{1{\cdot}5022} = 0{\cdot}9659.$
" F.	176·65 or 1·0000—	8·018 or 1·0000 and	$1{\cdot}0000^3 = 1{\cdot}0000$ and	$\frac{1{\cdot}0000}{1{\cdot}0000} = 1{\cdot}0000.$
" A.	197·42 or 1·1176—	8·325 or 1·0383 and	$1{\cdot}0383^3 = 1{\cdot}1194$ and	$\frac{1{\cdot}1194}{1{\cdot}1176} = 1{\cdot}0016.$

It will be observed that the relative economical efficiencies of the screws F and A, appear, as they should do, sensibly equal; while there is a slight discrepancy in what should be the equal economical efficiency of screws E and C; but in the case of screw E, there remains some doubt as to the piston pressure which is obtained by induction from the piston pressure of screw C; the discrepancy, however, is but little. The equal results thus obtained verify the equality previously inferred from the equal slips of the screws.

The following table exhibits in detail the data and results of the screws of expanding pitch radially, but of uniform pitch fore and aft:

	Vessel's draft of water in ft. and in.			SCREW.											ENGINES.			
				Diameter in ft. and in.	Pitches in feet and ins.			Number of blades.	Helicoidal area in square feet.	Length in direction of axis in inches.	Number of revolutions made per minute.	Slips of the screw in per cents. of its speed.			Gross average pressure in the cylinders in lbs. per square inch.	Number of double strokes of engines' pistons made per minute.	Horses power developed by the engines.	Speed of the vessel per hour in geographical miles 6062⅔ feet.
	Forward.	Aft.	Mean.		At hub.	Mean.	At periphery.					Of pitch at hub.	Of mean pitch.	Of pitch at periphery.				
*	4 6½	5 10½	....	4 6	4 10	5 1⅙	5 4	2	7·3	12	218·6	26·9	30·7	33·8	....	53·40	....	7·442
	4 6½	5 10½	....	4 6	4 10	5 1⅙	5 4	2	7·3	12	226·8	28·6	32·4	36·4	....	56·71	....	7·708
	4 6½	5 10½	5 2½	4 6	4 10	5 1⅙	5 4	2	7·8	12	220·2	27·8	31·6	34·6	8·212	55·06	136·84	7·575
†	4 7	5 11	....	4 6	4 8	5 9⅝	6 3	2	7·5	12	216·6	12·4	35·8	40·4	10·34	54·15	....	7·957
	4 6½	5 10½	....	4 6	4 3	5 9⅝	6 3	2	7·5	12	226·4	14·8	37·6	42·1	10·18	56·60	....	8·063
	4 6½	5 11	....	4 6	4 8	5 9⅝	6 3	2	7·5	12	224·0	14·6	37·3	42·0	10·99	56·01	....	8·014
	4 6⅗	5 10⅚	5 2¾	4 6	4 3	5 9⅝	6 3	2	7·5	12	222·8	13·9	36·9	41·5	10·5	55·59	176·65	8·018

* Screw E. { August 11, 1847. Sept. 18, "

† Screw F. { September 4th, 1847. " 18th, " October 14th, "

Screw of Expanding Pitch both Fore and Aft and Radially.—With a view to complete the series of experiments, a screw was tried having an uniform pitch at the hub of 4 feet 3 inches, expanding radially to the

periphery. The pitch also (except immediately at the hub,) expanded from fore to aft, the initial pitch at the periphery being 5 feet 6 inches, expanding to a final pitch of 7 feet, making the mean pitch at the periphery 6 feet 3 inches, and the ratio of expansion 21·4 per centum of the initial pitch. The rate of expansion from hub to periphery, calculated for the above mean pitch, was 47 per centum of the pitch at the hub. The mean pitch of the entire screw blade in function of surface, and of the square of the circumferential velocity of the surface, was 5·80 feet. This screw, which I shall call G, was 4 feet 6 inches in diameter, two-bladed, and 12 inches long; it was equal to screw F in all respects, except in the fore and aft expansion of the pitch; but the mean pitches of both screws were the same, viz: 5·80 feet.

With screw G two trials were made, the results of which are consistent with each other, and with the general results. The mean slip as given by these trials was 33·4 per centum; the mean slip of screw F was 36·9 per centum, or the slip of screw G was 3·5 per centum absolutely, or $\left(\frac{36{\cdot}9 - 33{\cdot}4 \times 100}{36{\cdot}9} = \right)$ 9·49 per centum relatively less. This difference in the slip is to be attributed to the expanding pitch fore and aft, and corroborates the comparative results from screw C of uniform pitch, and screw D of expanding pitch fore and aft. The relative economical efficiencies of screws F and G will appear from the following:

	Powers.	Speeds.	Effects.	Relative economical efficiencies.
Screw F.	176·65 or 1·0000—	8·018 or 1·0000 and	$1{\cdot}0000^3 = 1{\cdot}0000$ and	$\frac{1{\cdot}0000}{1{\cdot}0000} = 1{\cdot}0000.$
Screw G.	181·39 or 1·0268—	8·203 or 1·0231 and	$1{\cdot}0231^3 = 1{\cdot}0706$ and	$\frac{1{\cdot}0706}{1{\cdot}0268} = 1{\cdot}0427.$

Whence appears that with a screw of expanding pitch, a decrease of slip of 3·5 per centum (calculated for the mean pitch,) gives an increased efficiency of 4·3 per centum. Allowing for unavoidable slight errors of data, the increased efficiency was probably in the direct ratio of the decreased slip.

The following table exhibits in detail the data and results of the screw with expanding pitch both fore and aft and radially:

	Vessel's draft of water in ft. and in.†		SCREW.													ENGINES.			Speed of the vessel per hour in geographical miles of 6082⅔ feet.
	Forward.	Aft.	Diameter in feet and ins.	Pitches in feet and inches. At the hub.	Initial at the periphery.	Final at the periphery.	Mean for the whole screw.	Number of blades.	Helicoidal area in square feet.	Length in direction of axis in inches.	Number of revolutions made per minute.	Slip of the screw in per cents. of its speed. Of pitch at the hub.	Of initial pitch at periphery.	Of final pitch at periphery.	Of mean pitch for whole screw.	Gross average pressure in the cylinders in lbs. per square inch.	Number of double strokes of engines' pistons made per minute.	Horses power developed by the engines.	
*	4 6½	5 11	4 6	4 3	5 6	7 0	5 9⅝	2	5·95	9	214·2	10·9	31·1	45·9	34·7	11·33	53·55	....	8·001
	4 3	6 1	4 6	4 3	5 6	7 0	5 9⅝	2	5·95	9	216·6	7·4	28·5	43·8	32·2	10·93	54·16	....	8·406
	4 4¾	6 0	4 6	4 3	5 6	7 0	5 9⅝	2	5·95	9	215·4	9·1	29·8	44·8	33·4	11·13	53·85	181·39	8·203

* Screw G. { October 14th, 1847. June 30th, 1848. † Mean of forward and aft, 5 feet 2⅝ inches.

The following table contains a general summary of the data and re-

sults of the experiments. With screws of expanding pitches, only the mean pitch and slip corresponding to it are given. The quantities marked with a star (*) are doubtful. I am decidedly of the opinion that with screws of greater pitch and length than those experimented with, the gain obtained by the use of the expanding pitch fore and aft, would be much greater than is shown in the table.

General Summary of the Experiments.

Designation of screw.	Number of trials.	Vessel's draft of water in ft. and in.			SCREW.							ENGINES.			Speed of the vessel per hour in knots of 6086⅔ feet.	Relative economical efficiency of the screws in function of p'w'r exerted, & cube of spd. obt'd.
		Forward.	Aft.	Mean.	Diameter in feet and inches.	Pitch in feet and in.	Number of blades.	Helicoidal area in sq. feet.	Length in direction of axis in inches.	Number of revolutions made per min.	Slip of the screw in per cts. of its speed.	Gross average press. in the cylinders in lbs. per sq. in.	No. of double strokes of engines' pistons made per minute.	Horses power developed by the engines.		
Screw of Uniform Pitch.																
A.	4	4 5¾	5 11½	5 2⅝	4·6	5 10	2	7·10	12	230·9	37·3	11·3	57·73	197·42	8·325	1·0000
1st Mod. A.	3	5 6⅛	5 11	5 2⅝	4·6	5 10	2	5·97	10	233·3	39·6	10·4	58·32	188·56	8·110	0·9942
2d "	1	4 6½	5 10½	5 2½	4·6	5 10	2	4·93	8	237·8	41·7	9·91	59·45	178·30	7·972	0·9722
B.	1	4 5	6 0	5 2½	4·6	5 6	2	7·10	12	240·6	34·8	11·44	60·14	207·48	8·514	1·0182
C.	3	4 5½	5 11½	5 2½	4·6	5 0	2	7·20	12	254·0	31·6	10·7	63·48	205·56	8·576	1·0498
Screws of Expanding Pitch Fore and Aft, but of Uniform Pitch Radially.																
D.	3	4 5½	5 11⅞	5 2¾	4·6	5 0	2	7·20	12	236·6	26·2	10·8	59·15	193·34	8·615	1·1306
D reversed.	1	4 6½	5 10¼	5 2½	4·6	5 0	2	7·20	12	223·4	39·9	8·81	55·86	148·94	6·625	0·6680
Screws of Expanding Pitch Radially, but of Uniform Pitch Fore and Aft.																
E.	2	4 6½	5 10½	5 2½	4·6	5 1⅙	2	7·30	12	220·2	31·6	8·212	55·06	136·84*	7·575	1·0868*
F.	3	5 2⅜	5 10⅝	5 2¾	4·6	5 9⅝	2	7·50	12	222·3	36·9	10·5	55·59	176·65	8·018	0·9963
Screws of Expanding Pitch both Fore and Aft and Radially.																
G.	2	4 4¾	6 0	5 2⅜	4·6	5 9⅝	2	5·96	9	215·4	33·4	11·13	53·85	181·39	8·203	1·0410

General Conclusions.—From the foregoing experiments, the following are the general conclusions arrived at:—

1st, That with screws the same in all respects, except amount of pitch, the slip is in the simple ratio of the pitch, the greater pitch giving the greater slip; also, that the economical efficiency of the screw is in the simple inverse ratio of its pitch, the lesser pitch giving the greater efficiency.

2d, That the reduction of the surface of the same screw by cutting off portions by a plane passing through it perpendicular to the axis, is attended (within the limits experimented on) by an increase of slip, and by a decrease of economical efficiency.

3d, That with screws the same in all respects, except kind of pitch, the one having an uniform pitch throughout, the other having a pitch uniform radially, but expanding fore and aft, the mean pitch, however, being the same as that of the screw of uniform, the screw of expanding pitch has the less slip, and its economical efficiency is greater in proportion to the lessened slip.

4th, That with screws the same in all respects, except kind of pitch, the one having an uniform pitch throughout, the other having a pitch uniform fore and aft, but expanding radially from hub to periphery, the mean

pitch, however, being the same as that of the screw of uniform pitch, the slip is the same, and the economical efficiency is the same in both cases. Consequently, there is neither advantage nor disadvantage in using a screw with a pitch expanding radially from the hub to the periphery.

5th, That slip is a measure of the loss of power for producing useful effect; that it *causes* a loss of the total power developed by the engines equal to its per centage.

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*Locomotive Expenses on the Eastern Counties Railway.**

The number of miles run by the trains on this line, during the last half-year, was 1,625,274; the cost of working, £67,309; and the miles of railway worked, 434¼. And in the corresponding period of 1850, 1,185,628 miles were run; the cost of working, £85,070; and the length of railway worked, 327¾ miles. Showing an increase, in the length of railway worked, of 106½ miles; in the number of miles run, of 439,646 miles; and a decrease in the working expenses, of £17,761. The average cost of working, in the half-year ending the 4th of July, 1850, was 17·22*d.* per mile per train, including 13·89*d.* for locomotive power; and in the half-year ending the 4th of July last, the cost of working was 9·94*d.* per mile per train, including 7·88*d.* for locomotive power. Comparing the cost of working per mile per train in 1850, with that of 1853, a saving of £49,306 is shown on the half-year ending the 4th of July last. The increase in the number of miles run by the trains over that of the half-year ending the 4th of July, 1852, was 152,164 miles, attended by an actual decrease of expenditure of £894.

Simple Means of Preventing the Formation of Incrustations in Boilers.
By R. Fresenius.†

It has been found, since 1851, that no incrustation was formed in the boiler of a steam engine at Ems, whilst the water with which the boiler was supplied contained 21·899 grs. in the pound of solid matters. These were—

	grs.
Carbonate of soda,	11·35498
Sulphate of soda,	0·10790
Chloride of sodium,	7·27020
Sulphate of potash,	0·43653
Carbonate of lime,	1·24370
Carbonate of baryta,	1·06890
Carbonate of iron,	0·01728
Carbonate of manganese,	0·00868
Carbonate of baryta and strontian,	0·00215
Phosphate of alumina,	0·01090
Silica,	0·37889
	21·89951

From this Fresenius concludes that it is not carbonate of lime, but only

* From the London Practical Mechanic's Journal, September, 1853.

† From the London Chemical Gazette, No. 261.

sulphate of lime which causes the formation of crust, and that in the present case this is prevented by the quantity of soda contained in the water. This has given occasion to investigations, in which soda was added to water containing sulphate of lime, which hitherto had always deposited incrustations. In these cases the action was always found successful, so that Fresenius regards the addition of soda as the simplest means for the prevention of incrustation.

The author gives the following rule to prevent the addition of soda in excess:—100 parts of anhydrous sulphate of lime are decomposed by 78 parts of pure calcined soda. The discovery of the correct quantity is so simple and easy, that this circumstance does not present the least difficulty. Care must be taken that there be always a slight excess of soda present, and the water in the boiler must therefore be tested from time to time. This is better and more accurately effected than with test-paper, by dividing a sample (filtered if necessary) of the water of the boiler into two parts, and adding to one part solution of soda, to the other lime water. If the former remains clear whilst the other is rendered slightly turbid, the proportion is correct. If the reverse is the case, soda must be added, whilst its quantity can be diminished if the turbidity with lime water be very great.—*Journ. für Prakt. Chem.*, lviii. p. 65.

On the Analysis of the Gases from the Furnaces of Locomotives. By M. Sauvage, *Ingenieur-en-Chéf des Mines.**

[Extract from a Necrological Notice of M. Ebelmen.]

[We are indebted to the courtesy of a correspondent for the following paper, which will be of great interest to our readers after the report of Mr. D. K. Clark's paper "On the Principles of Locomotive Boilers," and the discussion thereon at the Institution of Civil Engineers, which has appeared in our pages. M. Ebelmen was, perhaps, of all others, the man best qualified to conduct the investigation, having for years dedicated himself to the analysis of the products of combustion in different furnaces. Our correspondent remarks that "the scientific deductions from experiment prove that Mr. Stephenson and those who supported his *opinion* were right, and that Mr. McConnell has applied his ingenuity in the *wrong direction*. It is clear that, properly constructed, *express engines* require no additional contrivance for consuming carbonic oxide, for there is none generated in the fire boxes of such engines."—Ed.]

Ebelmen, with myself as coadjutor, undertook a series of experiments, the object of which was the analysis of the gases issuing from the furnace of the locomotive engine. The results obtained from a considerable number of analyses prove the possibility of establishing a definite theory of this important class of furnaces, which have hitherto been constructed upon notions often contradictory. We have quite clearly proved that these furnaces are much more perfect than they are generally believed to be, and that the combustion is much more complete in the furnace of a locomotive than in that of any fixed engine.

* From the London Artizan, August, 1853.

The experiments were made on each of the three types of engine used on the Lyons Railway, viz:—

Passenger engine—not coupled.
Mixed traffic engine—4-wheel, coupled.
Goods engine—6-wheel, coupled.

The composition and nature of the gases varies, necessarily, with the quantity of air which passes through the fire; and this quantity depends, as we know, on the tension of the steam at the escape of blast pipe.

The proportion of carbonic acid contained in the gases of the locomotive is greater than is contained in the gases from ordinary fixed-engine furnaces; whilst the proportion of free oxygen corresponding to the excess of air in the draft is *less* from the locomotive furnace, a result clearly proving that there is a greater useful effect obtained from the fuel.

In the experiments on the passenger engines, and on the mixed traffic engines, the proportion of carbonic acid rose from 12·42 to 18·49 per cent. of the volume of gas, without there being any production of carbonic oxide. The higher per centage represents a result approximating very remarkably to the number 20·80, which represents the proportion of carbonic acid in the case of combustion *theoretically perfect*, or in which *all the oxygen* would be converted into carbonic acid.

The combustion in passenger engines is almost perfect, and in the mixed engine, provided the fire is attended to by an experienced stoker, it is nearly as good. These furnaces produce little or no carbonic oxide; the proportion of this gas rarely exceeds 2 per cent.

The goods engines, the grates of which are often charged with a great depth of coke, produce a greater amount of carbonic oxide. The quantity rose as high as 7·58 per cent., when the fire was 40 inches deep.

The composition of the gas varied according to the range of tube from which it was collected. It would certainly be possible to adopt arrangements which would permit of this carbonic oxide being usefully burnt, and thus improve the useful effect of the fuel in these engines.

During the stoppages of locomotives, or after the shutting of the regulator, the gases have a larger proportion still of carbonic oxide. It gets as high as 12 per cent. of the volume.

These results are quite in accordance with practical experience in reference to the consumption of fuel in these different engines. They indicate a limit of the depth of fire which it is wrong to exceed, and also what amount of economy can be effected by the intelligent employment of expansion and variable blast pipes, according to the depth of the fuel in the fire.

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*Railway Chairs.**

A gentleman who has seen Mr. Norris's patented method of chairing the rails on the London and North Western Railway describes it to us thus. He says it consists of a traveling furnace containing the melted iron, with a bellows to keep the fire up. Where there is a defective chair or a new one wanted, the old one is removed or broken off with the blow

*From Herapath's Journal, No. 732.

of a hammer, and the mould (which we presume must be in two parts) placed under the rail as it lies, the liquid iron is poured into it, and a new chair formed almost while one can say "Jack Robinson." As the iron of the new chair cools, it contracts and clips the rail with a grip much tighter than the present method of keying it. The iron of the old chair cast into the pot and remelted becomes material for a new chair. Thus a long length of line may be new chaired without any load of material or disturbance of the rails, and in a very short time.

We have not seen this process, and therefore can give no opinion of it; but taking it as described, there must be some provision at the rail joints for preventing the molten iron from getting between the ends of the two rails; for if not, by any great increase of temperature the whole line would burst up by the expansion of the rails.

AMERICAN PATENTS.

List of American Patents which issued from September 13, *to October* 11, 1853, (*inclusive,*) *with Exemplifications by* Charles M. Keller, *late Chief Examiner of Patents in the U. S. Patent Office.*

SEPTEMBER 13.

24. For *Improvements in the Gear of Variable Cut-off Valves for Steam Engines;* Matthias W. Baldwin, Philadelphia, Pennsylvania.

"The principle of varying the cut-off by means of a vibrating arm and sliding pivot block has long been known, but the contrivances for changing the position of the block upon the arm have been very defective. The radius of motion of the link by which the sliding block is changed on the arm, the radius of motion of that part of the vibrating arm on which the block is placed, have in this kind of valve gear, as heretofore constructed, been different, which produced a continual rubbing of the sliding block upon the arm while the arm is vibrating, and as the block for the greater part of the time occupies one position on the arm, and only has to be moved towards either extreme occasionally, that part of the arm on which the block is most used soon becomes so worn that the block is loose, and jars. This can only be remedied by dressing up the arm throughout its entire length; for if the brasses of the block were set up so as to make the block fit on the narrow portion of the arm, it could not be moved towards the extremes. To remedy these defects in the link motion, has long been a desideratum. The plan, however, of most engines now built, does not admit of the position of the parts of the old motion being so disposed as to avoid the difficulties specified, while my improvement can with the greatest facility be applied to any of them. This contrivance I have essayed, and find that it works well in practice, overcoming all the difficulties incident to the use of the numerous other gearing for variable cut-off valves of which I have a knowledge, and because of the superiority of this device in practice, I desire to patent it."

Claim.—"The arrangement of the sliding pivot block, fitted with a stem, connected with the sector by straps, chains, or cogs, the hand lever, and the intermediate connecting mechanism, as herein described."

25. For an *Improvement in India Rubber Soles for Boots and Shoes;* John Chilcott and Robert Snell, Brooklyn, New York.

"The nature of our invention consists in making the sole of three parts, viz: the india rubber sole, a leather lining, and a leather border."

Claim.—"What we claim is, constructing the whole or any portion of the sole of a boot or shoe, substantially as described, of india rubber, with its inside and edges covered and protected by leather, which is united with it by any water proof cement, with or without stitching, and forms a hard, firm, leather edge."

26. For an *Improvement in Cutting Boots and Shoes;* John Chilcott and Robert Snell, Brooklyn, N. Y.; patented in Belgium, Sept. 16, 1852; in France, Sept. 17, 1852; in England, Sept. 30, 1852.

"Our invention consists in a certain new method of cutting out, or otherwise forming a piece of leather or other material, so that it may be folded, without crimping and without the addition of gussets or other pieces, to take the required form of what is commonly termed the 'upper leather' of a boot, to fit any foot, heel, and leg, not positively deformed, with the greatest accuracy."

Claim.—"Having thus described the nature of our invention, and the manner in which we have used the same with perfect success, we do not claim the manufacture of boots without crimping; but what we do claim is, the form of the piece of leather or other material, substantially as shown and herein described, by which we are enabled to make what is termed the 'upper leather' of a boot to fit any leg, foot, and heel, not absolutely deformed, of one piece, without crimping or joining other pieces thereto; the distinguishing characteristics of this form being that one-half or side of the boot is formed by a part without joint, and the other half or side by the junction of a part folded from the back of the side, and a part which is partly cut from, or which when flat lays close or near to the front above the instep, and partly folded over from the instep; the part being of such form as to form one side of the foot, and extend round the heel to the other side, and cover an opening made in the lower part of the back, to give the required form to the heel, and also to make part or all of the necessary stiffening."

27. For an *Improvement in Bed Bottoms;* Pierre Demeure and Auguste Mauritz, City of New York.

"Our invention consists in an improved construction of spring bed bottoms, and bedsteads in combination therewith. The improvement in the spring bottom consists in giving elasticity transversely in combination with the vertical action of the spiral springs."

Claim.—"What we claim is, the manner of constructing the spring mattress by combining the vertical springs with an elastic spring network of spiral metallic springs, for supporting said vertical springs, or for increasing the elasticity, so that a person lying upon the bedside will be equally supported on all sides, as described."

28. For an *Improvement in the Shape of Scythes;* William P. Greenleaf, Washington, New Hampshire.

Claim.—"What I claim is, widening and curving the blade of the scythe at the shank, in the manner described, for the purpose of strengthening the same, and adapting it to cutting bushes as well as grass."

29. For an *Improvement in Safety Valves for Steam Boilers;* Zadoc H. Mann, Cincinnati, Ohio.

"My invention has for its object an increase of sensibility of the safety valve, so as to insure its opening at the desired maximum of pressure; and also so as to increase the size of opening in proportion to the force of steam, and thus insure an adequate vent for the steam under all circumstances, and thereby remove all danger or possibility of explosion with a suitable boiler."

Claim.—"What I claim is, the construction and application to a safety valve, of flutter wheel, governor, and supplementary lever, as described, or equivalent devices, in order to insure promptness of action, and an increase of vent, according to the force of steam; and this I claim either with or without the adjustable link and counter-weight, as described."

30. For an *Improved Revolving Mandrel for lining Cylinders with Metal;* George Potts, Cincinnati, Ohio.

"The object of my invention is, the production or manufacture of a pump, or other cylinder having a lining or interior casing of sheet copper, and the peculiar feature of novelty exists in devices for the application of said casing in such a manner as to give to the interior of the barrel a smooth, dense, and truly cylindrical surface, superseding the necessity of, and superior in its result to the fine boring and grinding now requisite."

Claim.—"What I claim is, the revolving mandrel, furnished with one or more rollers, whose distance from the axis of the mandrel can be increased or diminished by means of a nut, sleeve, and conical head, as described, or any equivalent device, for the purpose herein explained, of lining with one metal the interior of a cylinder formed of another metal."

31. For an *Improvement in the mode of Bucking Cloth;* Andrew Robeson, Jr., Newport, R. I.; patented in England, November 8, 1852.

"In my improved method of bowking, the pressure of the steam is not only employed to saturate the goods, but to assist and increase the filtration of the bowking liquor through them. The experiments I have performed have led me to discover by the use of my apparatus, a very great saving of time and labor in the bowking of cloth. I am led to believe that there will be not only a saving of at least fifty per cent. in time, but there will be a great saving in fuel over the common processes of bowking."

Claim.—"What I claim is, the employment of a closed kier or vessel, above described, and extracting the bowking liquor from the lower part of it, and forcing it into the upper part of it, while steam is being injected only into the upper part of the said vessel, and on the top of the goods, whereby, while the bowking liquor is being thrown on the top of the mass of goods, the steam is constantly and simultaneously made to press upon and pass into and through the goods, and facilitate the action of the bowking liquor, and its passage through the cloth, as stated."

32. For an *Improvement in Fences;* Hervey S. Ross, Cincinnati, Ohio.

"Two prominent objects of utility in my invention are its adaptation to situations exposed to heavy floods, and the easy removal of the fence from one place to another."

Claim.—"What I claim is, the herein described zigzag and interlocked arrangement of panels, supported by a swivel joint to posts at suitable intervals, and having the joint between the two middle panels furnished with inclined hook and eye, each of said middle panels being provided with boards sloping in opposite directions, so that by the action of a flood, each half of the intervening line of panels may separate midway, and swing in the direction of the current, or devices substantially equivalent."

33. For an *Improvement in Boot Jacks;* Samuel B. Sumner, Grantville, Massachusetts.

Claim.—"What I claim is, the application to an instrument for taking off boots, of the side bars, the shaft, and the bar, arranged and operating in the manner substantially as described."

34. For an *Improved Cutter Head for Moulding Machines;* Josiah M. Smith, City of New York.

"My invention consists in an improvement in the construction of cutter heads, for cutting mouldings in wood, marble, and other like materials. The object designed to be accomplished by me is the ability to put, and afterwards keep in order, the cutting edges of the series of chisels."

Claim.—"What I claim is, the combination of the slotted supporting flanches, or their equivalents, with the chisels, hinged and operated in the manner and for the purposes substantially as set forth herein."

35. For *Improvements in working the Valves of Steam Engines;* Richard H. Townsend, City of New York.

"The nature of my invention consists in a peculiar combination of the eccentric and cam, the eccentric working as usual when operating on the valve to give the engine steam nearly the entire stroke; the cam so shaped that when it is brought into operation, the valve is moved in such a way as to cut off at the smallest part of the stroke at which the engine is required to work. These motions are combined by means of a sector operated on by the governor, that when the governor balls fall in consequence of the increased power required from the engine diminishing the speed, the eccentric is brought into operation on the valve; and when the engine is doing little work, the operation of the governor by sliding the sector brings the cam into operation, to cut off, and allow the engine but little steam; the regulation of the position of the sector by the governor thus at any intermediate point or at the extremes, supplying steam and causing the valve to cut off, in proportion to the work to be performed; and by a peculiar apparatus, in case the valve does not supply the required steam to keep up the momentum, the throttle valve is opened farther, or the reverse operation is performed if the work be thrown off the engine so as to need little steam."

Claim.—"I am aware that the cam and eccentric have both been used to work the valves of a steam engine; therefore I do not claim them separately; but I am not aware that they have ever been combined by means of a sector, thereby bringing either the cam or eccentric into operation alone, or together, to give the valve a motion between the two extremes of a full supply and a quick cut-off, as required. And I am also aware that a

screw has been moved from a governor, to regulate the amount of steam or water supplied as active power to the engine; but I am not aware that the governor has ever been used to bring either the cam or eccentric into operation on the valve, by means of the screw or any other suitable device. Therefore, what I claim is, 1st, The combination of a cam and eccentric by means of the sector, or its equivalent, to operate on the valve, or parts that move the same, and cut off or work with the full pressure by the eccentric, according to the position of said sector, as described and shown. 2d, Adjusting the position of the sector by means of the governor, through the screw or other suitable means, whereby the governor regulates the position of the sector, to communicate the desired motion to the valve of the engine from the eccentric or cam, or both, according to the power required from the engine, as specified. 3d, The rod and points, to take motion from the block at its extremes of motion, and communicate the same by means of the right angle lever to the throttle or stop valves, as specified."

36. For an *Improvement in the manufacture of Plain and Figured Fabrics;* Frederick W. Norton, Lasswade, Great Britain.

"My said invention relates to the manufacture or production, under various modifications, of a novel class of plain or figured fabrics, applicable for a variety of purposes, but more especially for such uses as what are technically termed 'furnitures,' or furniture drapery, as usually applied to, as for example, table covers, curtains, tapestries, carpets, and trimmings."

Claim.—"Having now described and particularly ascertained the nature of my invention, and in what manner the same is or may be used or carried into effect, I may observe in conclusion, that I do not confine or restrict myself to the precise details or arrangement which I have had occasion to describe or refer to, as many variations may be made therefrom, without deviating from the principles or main features of my invention; but what I consider to be novel and original, and therefore claim, is, 1st, The manufacture of woven fabrics by cross weaving, by carrying the cross warp alternately over a stationary warp, and binding the cross warp on each side of the stationary warp by a shot of filling. 2d, Carrying contiguous movable cross warps over and across each other's path, and over one or more stationary warps, and binding said cross warps to the stationary warps by shots of filling. 3d, The manufacture of ornamental fabrics, by cross weaving elongated printed warps, as described."

37. For an *Improvement in Hanging Mill Saws;* James Rankin, Detroit, Michigan.

"The nature of my invention consists in providing mill and other saws at one or both ends with a cylinder and piston, said piston being coupled to the end of the saw by its rod; then, by applying atmospheric or other pressure, with any elastic fluid, on the side of the piston nearest the saw, any desired tension may be obtained on the saw, (while it is at perfect liberty to reciprocate following the piston, and vice versa,) thereby obviating the heavy sash or frame, while its qualities are retained, and the speed of the mully saw may be obtained without its weight and thickness, and consequent loss of power and timber."

Claim.—"What I claim is, the arrangement of an air chamber cylinder and valve, in the manner substantially described, for the purpose of straining saws in motion, by the elastic pressure of compressed air, or its equivalent."

38. For an *Improvement in Screw Fastenings for Boots and Shoes;* John Chilcott and Robert Snell, Brooklyn, New York.

"The object of our invention is, to make a screw fastening that will hold the parts together with perfect security, and at the same time allow the inner and outer surfaces of the sole to be made as smooth and even as when other means of security or attachment are used. This screw fastening consists of a double metal screw, or two male screws of different sizes, of which the larger is hollow, and contains a female screw to receive the smaller. These screws are inserted through the sole from opposite sides; the smaller being inserted from the inside, and the larger being screwed in from the outside, the latter screwing into the sole, and screwing on to the male screw, and drawing the parts together like a screw and nut."

Claim.—"What we claim is, the combination as and for the purposes herein described, of the two screws, of which one forms a nut for the other, and will hold it secure until all worn away."

39. For an *Improvement in Lard Lamps;* Leonard A. Stockwell, Batavia, N. Y.

Claim.—"What I claim is, the combination of the reservoir of a lamp for burning lard

or tallow, with an outer covering, so arranged as to form an air chamber surrounding the reservoir, in the manner and for the purposes herein mentioned."

SEPTEMBER 20.

40. For an *Improved Machine for Sawing Sticks for Broom Handles;* Thomas J. Alexander, Westerville, Ohio.

Claim.—"Having described my invention, what I claim is, the method herein described of handling and adjusting the log to its place, and to its various positions, for the several cuts, by means of the radius rods or clamping screws, coupled and operated as specified, and suspended by a swinging frame from above, arranged and operated together, as herein set forth; so that by bearing laterally on the screw lever or handle whilst turning it, the clamping screws are swung laterally, and raised or lowered simultaneously, to approach the log on the table, and convey it with facility to the gauge, and to adjust the log expeditiously, when under operation, to its various sets, laterally and vertically, as shown and described."

41. For an *Improved Planetary Hydraulic Steam Engine;* James Black, Philadelphia, Pennsylvania.

Claim.—"What I claim is, the arrangement of the vessels, pipes, and diaphragms, or their equivalents, upon a shaft, so as to revolve with or upon said shaft, substantially as described, for the purposes set forth."

42. For an *Improvement in Turbines;* Uriah A Boyden, Boston, Massachusetts.

Claim.—"What I claim is, 1st, The leaning or inclining of the leading curves or guides to the plane of the wheel, as described. 2d, The making of the inside of the garniture, or the part of the gate next the disk, or both, of such a curvature or form, that the water at the upper part of the stream or streams, where it leaves the garniture or gate, will have a downward motion, or a direction inclining to the plane of the water wheel, and making the upper sides of the passages for the water through the wheel descending or inclining to the plane of the wheel, from the commencement of the passages next the gate to about half-way from the inner to the outer edge of the upper rim of the wheel, where they are nearly or quite horizontal, or nearly or quite parallel with the plane of the wheel; the inclination of that part of the lower surface of the upper rim of the wheel which is next the gate, being the same or nearly the same as that of the lower surface of the gate next said upper rim, and the change from inclining to horizontal being gradual, as by a curve; or making the upper surface of the disk, next the lower rim of the wheel, to incline up toward this rim, and making the lower sides of the parts of the passages through the wheel, which are next the disk, ascending or inclining to the plane of the wheel, so that the stream or streams will gradually diminish in height at the entrance or entrances into the wheel, so that the water which passes in the upper parts of the stream or streams will converge toward that which passes in the lower parts of the stream or streams, before striking the floats, and continuing this converging into the wheel to about one-half the distance from the inner to the outer edges of the rims of the wheels. 3d, The forming of the lower part of the tube which sustains the disk, and the forming of the top of the disk on that part of it next the tube, and fastening these parts together, as above described. I have, in sundry parts of this description and claim, for brevity, written of the turbine as having its common position, in which case the water descends, to pass between the leading curves, without alluding to its ever having any other position; but I do not limit either division of my claim to the case when it has the common position; but I extend my claim to the cases in which the wheel is vertical or inclined to the horizon, and to the case when the water ascends to pass between the leading curves; nor do I limit either division of my claim exactly to the forms above described, but I extend my claim to all forms which are essentially the same."

43. For an *Improvement in Turbines;* Uriah A. Boyden, Boston, Massachusetts.

Claim.—"What I claim is, 1st, The arrangement of a gate at the entrance of the water into the wheel, with a part or all of the garniture or lining, and other parts of the turbine within, over, and about the gate, such that the gate and a part of the garniture, if any be attached to it, may move freely, while the part of the garniture not attached to the gate, and other parts over and about the gate, remain stationary, and so closely fitted that little or none of the water in the flume can run to the upper part of the gate, excepting by passing under the stationary garniture, and afterward upward, so as to diminish the liability of sediment, dirt, or other substances being carried by the water to the upper part of the

gate, or movable part of the garniture, if any be attached to the gate, so as to obstruct the motion of the gate, or movable part of the garniture, essentially as above described. 2d, The leaning or inclining of the floats or buckets of turbines to the rims of the wheels, so that when the wheel of a turbine is working, with the gate next the wheel partially open, the parts of the floats opposite the aperture formed by such partial opening of the gate, will be forward of those parts next the other rim of the wheel, so that the leaning of the floats will diminish the spreading or deflecting of the streams into the part of the wheel opposite the gate, essentially as above described; though I do not limit my claim to any degree of inclination, but extend it to all degrees of inclinations, which will substantially answer the same purpose, as this effect of inclining the floats depends on the streams only partially filling the wheel. I do not extend my claim to inclining the floats to any such turbine or hydraulic motor as has no gate at or near the water wheel, or other means of varying the width, thickness, or number of streams which enter the wheel. 3d, The arrangement of the diaphragms or partitions in reacting wheels, and in the wheels of turbines, at different distances from the rims of the wheels, in the several spaces between the floats, to facilitate regulating the motions of the wheels, essentially as above described; though I do not limit my claim to any particular arrangement as to the distances of these diaphragms from the rims of the wheels, but extend it to all arrangements which operate substantially as above described. But as the effect of these diaphragms depends on the streams only partially filling the wheels, I do not extend my claim to this arrangement of the diaphragms to such motors as have no gate next or near the water wheels, or other means of varying the width, thickness, or number of streams which enter the wheels. 4th, The combination of the device of making the gate at the entrance for the water into the wheel, to move separately from the garniture, with the leaning guides or leading curves, which direct the water into the wheel, so that when the gate is partially open, the part of the water which passes by or near the surface of the gate, in flowing toward this passage into the wheel, made by such partial opening of the gate, has its motion directed the way the wheel turns, in consequence of the leaning of the said guides. I do not confine my claim exactly to any degree of leaning, but extend it to all degrees of leaning which will essentially answer the same purpose. I do not limit either of these four branches of my claim to such turbines or hydraulic motors as discharge the water at their peripheries, but I extend them to such as have the water enter their wheels at their peripheries."

44. For an *Improvement in Hydraulic Motors;* Uriah A. Boyden, Boston, Mass.

Claim.—"What I claim is, 1st, The arrangement of the gates around and next outside of the peripheries of the water wheels, between the wheels and the guides, or other things which cause the water to move obliquely toward the wheels in the way the wheels turn, when the water first strikes the floats or buckets, essentially as above described. 2d, The device to cause the height of the wheel, or the position of the parts which partially confine the water which presses the wheel upward, to vary as the height of the water or fall varies, so that the width of the aperture which lets the water escape from the place where it presses the wheel upward, varies proportionally to the quantities of water pressed into it; so that the force with which the water presses the wheel upward will be nearly or quite constant, though the height of the fall varies greatly. 3d, The combination of a gate around and near the periphery of a water wheel, between the wheel and the guides, or other things which direct the water the way the wheel turns into the wheel, with the parts of the floats near the gate curved, so that the water will strike their concave sides, as above described; though I do not limit my claim exactly to any curvature of the floats, but extend it to all curvatures which will essentially answer the same purpose; nor do I limit my claim to an annular gate, between the wheel and the things which cause the water to move the way the wheel turns, before it enters the wheel, but I extend it to all things which will substantially answer the purpose of a gate, in varying the height, thickness, width, or number of streams that enter the wheel. 4th, The shape of the spaces between the rims of water wheels, which the floats are fastened to, in which they flare toward the axes of the wheels, as above described; though I do not limit my claim to exactly the flaring above described, but extend it to all flaring which will essentially answer the same purpose. The first, third, and fourth branches of my claim apply only to such hydraulic motors as have guides, or other things which cause the water to move obliquely toward the wheels, in the way in which the wheels turn, and pass into the wheels at their circumferential parts, and after acting on the floats, discharge from the floats inward; I do not extend these divisions of my claim to the class of tub wheels and undershot wheels, in which the water generally flows into the wheels in streams, with spaces between the streams, at which spaces the water does not flow into the wheels. Though I have de-

scribed these water wheels as being horizontal, and the gates as being opened by raising, it is obvious that all these four branches of my claim are quite applicable to wheels in other positions, and to cases in which the gate is opened by lowering; and I do not limit either branch of my claim to cases in which the wheels are horizontal, or to cases in which the gates are opened by raising."

45. For an *Improvement in Razor Straps;* Alfred F. Chatman, City of New York.

Claim.—"I claim the metallic renovator, in combination with the spring barrel, or its equivalent, to operate on the strap, as specified. I also claim the convex end and rest, to elevate the centre of the strap, as described and shown."

46. For an *Improvement in Railroad Car Seats;* Isaac Fay, Cambridge, Mass.

Claim.—"I claim the combination of the groove, and one or more dogs, as applied thereto, and made to operate for the support of the back, and to enable it to be elevated, or its supporting pin raised out of the groove, as described. And in combination with the inclined notches and long slot of each bar, I claim the sliding bolt or slide, as applied thereto, and used substantially in manner and for the purpose as specified. And I claim the convex and concave toothed racks, in combination with the seat and the chair frame, the same being for the purpose of enabling the seat to be set with such inclination, either forwards or backwards, as may be conducive to the ease and comfort of the sitter, whether he be in an upright or recumbent position."

47. For an *Improvement in Toilet Furniture;* David Freed, Huntington, Penna.

Claim.—"Having fully described the nature of my invention, what I claim is, the attaching or combining with a washstand, or any other toilet or chamber furniture, the brackets and bolt, when said bolt is thrown against the brackets by means of a crank or knob, at or near the top of the stand, through the levers or their equivalents, in the manner and for the purpose herein set forth."

48. For an *Improvement in Ploughs;* Samuel Hulbert, Ogdensburg, N. York; patented in Canada, September 20, 1852.

Claim.—"What I claim is, constructing a mould board of a plough, so that a horizontal line, drawn at any height across its working side, shall describe the convex arc of a given circle, and any line drawn across its working side at right angles to the base, shall also describe the convex arc of a circle, substantially as set forth."

49. For an *Improvement in Seed Planters;* Samuel Jenkins, Portsmouth, Penn.

"The nature of my invention and improvement consists in attaching an adjustable cutter to and through the drag bar, and through the point of the shovel."

Claim.—"What I claim is, the peculiar shape and construction of the adjustable cutter; its passing through the drag bar, and fitting in a dovetail in the point of the shovel; all in combination as herein described, for the purpose of allowing the tooth to pass easily over any obstructions, and especially to regulate the depth of furrow."

50. For an *Improvement in Hemp Brakes;* Oliver S. Leavitt, Marcellus, New York.

Claim.—"I do not claim as my invention the beating of flax or hemp straw into grooves, for the purpose of divesting it of the shives or woody portion thereof, or the use of rollers, for moving the material to be broken, as that has been done before; but what I do claim is, the combination of a reciprocating beater, with parallel blades, set at decreasing distances from each other, with a fixed bar, fluted or serrated, to correspond with the blades and spaces of the beater."

51. For an *Improvement in Drawing Frames for Hemp and Flax;* Oliver S. Leavitt, Marcellus, New York.

Claim.—"I make no claim to the use of gill bars, attached to chains or wheels, in drawing flax, hemp, and other fibrous substances, as this has been often done before. But I do claim, 1st, The particular form of gill bar described, in combination with the rocking lever, the dog, and cam or tappet, for the purpose of withdrawing the gill pins from the material, and directing the bar's backward movement, in the manner and for the purpose substantially as set forth. 2d, The device by which the rods are pressed down, for the purpose of making the gill pins penetrate effectually the material to be drawn, being operated by the lever in the manner set forth."

52. For an *Improvement in Metal Drills;* Warren Lyon, City of New York.

Claim.—"I do not claim the weight attached to the arbor, irrespective of the levers and

counterpoise; nor do I claim any of the within named parts separately: but what I claim is, the combination of the weight, levers, and counterpoise, constructed, arranged, and operating in the manner and for the purposes substantially as herein shown and described."

53. For an *Improvement in Oil or Fluid Cans;* James R. Nichols, Haverhill, Mass.

Claim.—"I do not claim as my invention the helical spring and cork valve, as applied to other purposes than that of a decanting vessel, or lamp feeder; but what I do claim is, the application to the same of a spring valve or valves, easily and conveniently opened by the thumb or finger, while replenishing lamps or decanting therefrom, whether said spring and valves be made and arranged in the manner as herein described, or other mode substantially the same, by which similar results shall be produced."

54. For an *Improvement in Seed Planters;* Henry Perrin and William Rudduck, Wilmington, Ohio.

Claim.—"Having described our improvements in seed planters, what we claim as new is, the method of supplying the distributing tube with grain or seed from the hopper, by means of the reciprocating or vibratory valve in the hopper, in combination with the cap, and discharging plate and receiving chamber, constructed, arranged, and operating as described."

55. For an *Improvement in Grain and Grass Harvesters;* Philo Sylla and Augustus Adams, Elgin, Illinois.

Claim.—"What we claim as our invention is, 1st, The weighted levers or their equivalents, substantially as described, which carry the sickle bar and sickle, and allow them to vibrate perpendicularly, and accommodate the sickle to uneven ground in cutting grass, which levers may be made permanent when cutting grain, substantially as described and represented. 2d, The link, or hinged brace, or its equivalent, in combination with the weighted levers, which brace prevents the sickle bar from being traversed longitudinally by the action of the sickle, but allows it to vibrate perpendicularly, and accommodate itself to uneven ground, substantially as described. 3d, The stands of the binders, constructed so as to allow them to stand so much lower than the horizontal platform, that they can bind the gavels into sheaves with greater facility, far less labor, and much faster, than by any of the modes heretofore practised."

56. For an *Improvement in Blow Pipes for enlarging Blasting Cavities;* Ancil Stickney, Norwich, Vermont; ante-dated June 11, 1853.

Claim.—"I do not claim the enlarging a drill hole by the use of heat or a blast of air, thrown upon charcoal or other fuel in a state of combustion; but what I do claim is, my improved process of enlarging the drill hole by means of an air blast and charcoal or other combustible fuel, placed in the hole—the same consisting in the employment of a blast tube, made with lateral projections, and a closed or nearly closed bottom, substantially as described; the same enabling me to attain the enlargement of the hole, with a great saving of labor and time, essentially as set forth."

57. For an *Improvement in Compound Blow Pipes for enlarging Blasting Cavities;* Ancil Stickney, Norwich, Vermont; ante-dated May 10, 1853.

Claim.—"I lay no claim to the use of a blast of air or gas, in connexion with coal or fuel, and for the purpose of supplying such with oxygen; but what I do claim is, the instrument for enlarging the drill hole by the employment of gas, as specified; meaning to claim the combination of the two jet chambers, the perforations or orifices, and supply tubes, as arranged substantially in manner and for commingling the gases, and disseminating the flame therefrom entirely around and against the sides of the drill hole, whereby the enlargement of it into a suitable charge chamber may be speedily effected."

58. For an *Improvement in Steam Generators;* Abel Shawk, Cincinnati, Ohio.

Claim.—"Having fully described the nature of my invention, what I claim therein is, a tubular generator, which has a forced circulation, and which, while it lines the fire-box, and is expanded in its diameter from above the fire-box to its termination, is connected to a steam chamber or receiver, outside of or exterior to it, arranged in the manner described."

59. For an *Improved Saw for Water Wheels;* Oscar Willis, County of McDowell, N. C.

Claim.—"Having fully described the nature of my invention, what I claim is, an ad-

justable apparatus for sawing out the grooves or fillets in water wheels, for the reception of the buckets, composed of a two-edged saw, between clamps, and connected by a screw rod to a sliding bar, when said sliding bar is made adjustable upon a radius arm hung to the centre of the wheel—the whole being combined and operating substantially as described."

60. For an *Improvement in Cotton Stalk Cutters or Pulverizers;* George Gorman, Lamar, Mississippi.

Claim.—"What I claim as my invention is, the construction and arrangement of the machine, consisting of rotary whippers or reels on a bar, supported in a frame, admitting of elevation and depression—said whippers being driven by band wheels on one or both supporting wheels of said machine, in the manner set forth, for the purpose of effectually reducing the stalks of cotton, and thus rendering them useful as a manure, and in a condition to offer no obstruction to the plough, in the after cultivation of the land."

SEPTEMBER 27.

61. For an *Improvement in Looms for Weaving Hair Cloth;* Halvor Halvorson, Hartford, Connecticut.

Claim.—"What I claim is, the combination of the trough or troughs, one or two depressers, one or two sets of pincers, applied to the shuttle, and mechanism for opening and closing the pincers; the whole being applied to one or both ends of the lay and to the shuttle, and made to operate together substantially in the manner and for the purpose of carrying hair or hairs, or like matters, into the shed of warps, as specified. And I also claim the arrangement of each or both troughs with respect to the depresser or depressers thereof, and to the shuttle boxes and the lay, substantially as represented in the drawings, the trough in such arrangement being made to extend from the depresser towards the middle of the lay, substantially as specified."

62. For an *Improved Sash Fastener;* Henry Hochstrasser, Philadelphia, Pa.

"My improved fastening is designed to secure the window more effectually, and is stronger and more durable than those heretofore made."

Claim.—"What I claim is, the self-acting catch, made and operating substantially as described."

63. For an *Improvement in Cooking Ranges;* Nicholas Mason, Roxbury, Massachusetts.

"The nature of my invention consists in the adaptation of two ovens to the range, and in such an arrangement of flues, that either one or both of them may be heated as required."

Claim.—"I am aware that hot air chambers have been applied to ranges, for the purpose of heating meats, dishes, &c.; and also that hot water spaces have been applied to the sides of the grates, instead of at the back: I therefore lay no claim to such devices, although I have introduced a description of them, to facilitate the understanding of my range. But what I do claim is, the employment of two ovens, in combination with the peculiar arrangement of the flues around their top, bottom, back, and sides, by which I am enabled to heat five sides of either one or both of them at a time, as set forth."

64. For an *Improvement in the Manufacture of Sheet Iron;* Henry M'Carty, Pittsburg, Pennsylvania.

"The object of my invention is to impart to sheet iron in its manufacture, the beautiful mottled appearance presented by imported Russia sheet iron. The invention consists in the use of planished or hammer-dressed rollers, between which the sheets of iron are passed, after having been prepared according to the process described in my patent of June 29, 1852. These rollers are arranged similar to those of a common rolling mill, and reduce the iron but slightly; their surfaces, which present the appearance seen in the drawings, giving the sheet passed through them the glossy mottled appearance desired."

Claim.—"I do not claim the use of rollers generally; but what I do claim is, imparting to the surface of sheet iron the peculiar mottled appearance of Russia sheet iron, by passing the sheet between a pair of planished or hammer-dressed rollers, in the manner substantially as herein fully set forth."

65. For an *Improvement in Cooking Stoves;* Jordan L. Mott, City of New York.

Claim.—"1st, I do not claim as my invention, any particular mode of securing the top plate of the bottom flue to the series of flue tubes; this may be done in various ways. But what I do claim as my invention is, connecting the top plate of the bottom flue with the

lower part of the series of flue tubes, so that in taking out the series of flue tubes for cleaning, the said top plate of the flue below shall be removed at the same time, and thereby expose to view the lower flue space, greatly facilitating the operation of cleaning. 2d, I do not claim hanging the grate, irrespective of the combination, as my invention. What I do claim as my invention is, the combination of a swinging grate, as described, with the self-acting weighted latch, connected with the plate below the grate as specified, whereby the contents of the grate can be readily discharged, and the grate readjusted by a slight use of a poker."

66. For an *Improvement in Bathing Tubs;* Jordan L. Mott, City of New York.

Claim.—"I do not limit myself to any particular form for the projection, nor to the forms of the channels therein, as these may be varied at pleasure, although I prefer to make the whole as described; nor do I wish to limit myself to the making of the two channels in one and the same projection, as they may be made each in a separate projection, and located at different parts of the tub; nor, finally, do I wish to limit myself to the use of the two channels in combination, as the use of either one of them will greatly improve the bathing tub. I do not claim broadly as of my invention, the connexion of the hot and cold water pipes of a bath tub, so as to discharge hot and cold water together, as this has before been done by a pipe or pipes coupled with the bottom of a tub, and discharging upwards. Nor do I claim broadly the use of an overflow pipe, for carrying off the water, and preventing the water in the tub from overflowing, as a separate device has before been used for this purpose; but when so used, it was so connected with the waste and supply pipes as to necessitate the use of a valve within the waste pipe, with all its attendant disadvantages. What I do claim as my invention is, the before described mode of combining with a bathing tub either one or both of the channel ways, substantially as described, and making, when constructed, part of the tub, one of which channel ways connects the overflow and the waste or discharge holes with the waste pipe, and the other channel way is adapted to the insertion of the hot and cold water pipes, and discharging the hot and cold water together at or near the bottom of the tub, and in a horizontal or nearly horizontal position, substantially in the manner and for the purpose specified."

67. For *Improvements in making Chains;* Christian Sleppy, Newport, Pa.

"The nature of my invention consists in making chains as aforesaid, by a machine more fully specified hereafter."

Claim.—"What I claim is, the forging and making chains out of a solid bar without the welding process, and which is done instantly, as the bar passes between four rollers, with dies on the edges of the same, moulding the links into form, and which may be done out of iron, brass, or any substance suitable to be used as a chain, from the size of a cable to a watch guard."

68. For *Improvements in Annealing Hollow Iron Ware;* David Stuart, Philadelphia, Pennsylvania.

"The nature of my invention consists in covering the inside of iron hollow ware with a paste made of a composition to exclude the air, and which resists the influence of the heat; when the hollow ware is properly prepared in this manner, it is placed in the oven, and heated to a cherry-red, whereby the chill is taken out of the surface, and rendered so soft that it can be turned bright in a turning lathe, or otherwise, preparatory to tinning."

Claim.—"What I claim as my invention or improvement in annealing hollow ware is, the process herein above substantially as described; the same consisting in coating the articles in the manner set forth, with the same composition that will resist heat and exclude air from the surface, and heating the articles so coated in an oven about the length of time specified."

69. For an *Improvement in Smut Machines;* Robert Waskey, Mill Creek, Virginia.

"My invention consists in inserting between the head of the beating cylinder and the fan chamber, a diaphragm with inclined openings, for the purpose of preventing the grain from being carried off with the smut by the action of the blast during the operation of cleaning."

Claim.—"What I claim is, the construction of the diaphragm, the central part being solid, and that near the periphery made in several oblique valvular passages, to check and throw back the kernels of grain, as represented."

70. For an *Improvement in Smut Machines;* William Zimmerman, Quincey, Illinois.

"The nature of my invention consists of a series of two or more stationary cones, with

one, two, or three, or more revolving cones, placed alternately between the stationary cones; the insides or outsides of part or both sides of part or all the cones may be furnished with roughened surfaces, of such a form or kind as will perform the service required."

Claim.—"What I claim in the above described machine for cleaning and scouring grain, hulling rice, pearling barley, hulling buckwheat, or otherwise operating upon grain, seed, &c., is, a series of two or more stationary cones, with one, two, or three, or more revolving cones, placed and operating alternately between the stationary cones; the insides or outsides of part, or both sides of part or all the cones being furnished with roughened surfaces, of such a form or kind as will perform the service required, substantially as described."

71. For *Improvements in the use of Steam for actuating Engines;* Charles E., John, and Samuel Wethered, Baltimore, Md.; patented in England, May 25, 1853.

Claim.—"What we claim as new is, the combining steam and super-heated or surcharged steam, for actuating engines, when generated, the elasticity increased, and operated as set forth."

72. For an *Improvement in preparing Pariffine Oil;* William Brown, Glasgow, Scotland.

Claim.—"1st, I claim the use of super-heated steam as indicated for the purpose indicated. 2d, I claim the mode of separating and purifying Eupione lubricating oil and paraffine, obtained by previous process."

73. For an *Improved Method of Veneering;* Caleb B. Burnap, Assignor to Lucius F. Robinson, Hartford, Connecticut.

"The object of my invention is to make a more perfect and equal pressure on the surface of veneers, in gluing or cementing them, than can be obtained by any other plan heretofore known to me."

Claim.—"What I claim is, the method of pressing veneers on to the surface to which they are to be glued or cemented, by means of a fluid, hot or cold, acting on an interposed flexible substance, such as an india rubber cloth or its equivalent, which will adapt itself to the surfaces, substantially as described."

74. For an *Improvement in Car Wheels;* Daniel P. Fales, West Poultney, Vermont.

Claim.—"I am aware that car wheels composed of two side plates of different shapes cast in one piece with the hub and rim, in which the rear plate is made to combine the inner end of the hub with the face plate, and with alternate portions of the inner edge of the rim, have been made by Bristol and Jackson; and therefore do not claim to be the inventor of this description of car wheels. But what I do claim is, my improved car wheel, composed of the face plate, which curves first inwards and then outwards, and expands into the rim, and the rear plate, which by the series of curves represented, combines the inner end of the hub with the face plate, and with alternate portions of the inner edge of the rim, substantially as herein set forth."

75. For an *Improvement in Railroad Switches;* James M. Dick, Buffalo, N. York.

"The nature of my invention consists in the construction of the sliding bar, to which the ends of the switch rails are attached, with depending flanches or side plates enclosing the slide and the cross piece upon which it works, for the purpose of affording an effectual and certain protection against gravel, dirt, snow, rain, sleet, ice, and other foreign substances, which might otherwise enter between them, and interfere with the operation of the switch."

Claim.—"I do not claim the levers, springs, bolts, or connecting rods; neither do I claim of itself the employment of a sliding bar connected to the switch. But what I do claim is, the construction of the slide, with the depending flanches or side plates, which enclose the slide and cross piece upon which it works, and afford a certain and effective protection against gravel, dirt, snow, sleet, ice, and other foreign substances, which might otherwise enter between them, and derange the operation of the switch."

76. For an *Improvement in Ships' Blocks;* Charles H. Platt, City of New York.

Claim.—"I do not claim the plates for the purpose of securing the cheeks the proper distance apart, for they have been previously used; but what I claim is, the employment or use of the rods passing through the cheeks, in a direction transversely of their fibre, for the purpose of preventing the splitting of the cheeks; said rods also securing the plates to the cheeks, and forming a staple for the hook, as herein described. I also claim the rods

placed underneath the ends of the shaft, for the purpose of preventing the wearing of the cheeks, and thereby forming durable bearings for the shaft, as set forth in the body of the specification."

77. For an *Improved Centrifugal Draining Machine;* William Richardson, New Orleans, La.

Claim.—"Having described the nature of my improved draining machine, what I claim is, the arrangement in the tub of the induction tube, supply bulb, and annular tube or ring, placed below the water line exterior of the tub, in combination with the ascending tubes, and a second annular tube, having discharges, for the purpose of self-priming, protecting the machine from the resistance of water exterior thereto, and giving steadiness to the ascending column of water discharged by the machine."

78. For an *Improved Clamp for laying Floors;* Stephen E. Parrish, City of New York.

"The nature of my invention consists in making a brace having a forked end, with shoulder pieces attached to the under side thereof, so as to straddle one of the flooring beams, in combination with a screw working at right angles to the brace, and having on it a ratchet wheel and lever and pawls, for working up the screw against the edge of the plank."

Claim.—"What I claim is, the use of the brace having clawed ends, for acting at opposite sides of a beam, in combination with a screw working at right angles to the same, substantially in principle of construction and operation as set forth."

Additional Improvement.

1. For an *Improvement in Winnowers and Threshers;* George F. S. Zimmerman, Charleston, Va.; dated Sept. 13, 1853; patented Feb. 8, 1853.

Claim.—"I claim constructing the suction pipe or tube, of any desired form, with a sliding hinged flap bottom, attaching said pipe or tube to the grain discharge or bagging spout, having a sieve-like or reticulated bottom, and using said attachments in combination, for the purpose of cleaning, and chaffing, or double winnowing grain of all kinds, with a blowing blast of air, and a suction draft or current of wind also in combination, and in one operation, and at the same time, for the purpose specifically as set forth. I do not, however, claim inventing or originating the double cleaning of grain, but simply the peculiar combination above mentioned."

Re-Issue for September, 1853.

1. For an *Improvement in Figure or Fancy Power Looms;* William Crompton, Hartford, Conn., late of Taunton, Mass., Assignor to Merrill A. Furbush and George Crompton, Worcester, Mass., Sept. 13, 1853.

Claim.—"Having fully described my invention and the modes of carrying it into effect, what I claim is, 1st, The jacks with hooks or projections thereon, capable of being taken or passed by the lifter and depresser, as required, in combination with the harness or heddles, for the purpose of opening the sheds. 2d, The combination of the jacks, constructed and arranged substantially as described, with the lifter and depresser as described. 3d, The combination of the pattern chain or cylinder with the jacks, constructed in the manner described. 4th, Arranging and connecting the lifter and depresser, which operate the jacks in such a manner that they shall operate simultaneously to elevate and depress the jacks and warps in forming the shed, substantially as described. 5th, Giving motion to the pattern chain or cylinder, substantially as described. 6th, The combination of the pattern chain or cylinder, with the jacks, lifter and depresser, as described. 7th, So constructing or arranging the lifter and depresser and the hooks or projections on the jacks, with reference to each other, substantially as set forth, as to bring the upper warps all into the same plane, and the lower warps all into another, when the shed is opened. I do not claim broadly the bringing of the warps into said planes. 8th, Connecting the hook jacks to the bottom treadles or levers by inclined wires, or their equivalents, to hold the jacks against the tubes or bars of the pattern cylinder or chain, when not thrown out by the rollers or other projections thereon."

DESIGNS FOR SEPTEMBER, 1853.

1. For a *Stove;* S. W. Gibbs, Albany, New York, Assignor to North, Chase & North, Philadelphia, Pennsylvania, September 6.

Claim.—"I claim the raised shield, the lance border, the scrolls, and the borders, forming an ornamental design for a stove."

2. For a *Cooking Stove;* William P. Gray, Penn Township, Assignor to Abraham and Joseph Cox, Philadelphia, Penn.

Claim.—"I claim the design, configuration, and arrangement of the mouldings, panels, and ornaments on the front, back, and side plates of the stove, called 'The Model Parlor Cook,' as fully set forth."

OCTOBER 4.

1. For an *Improvement in Car Wheels;* Joel Baker, Boston, Massachusetts.

Claim.—"What I claim as my improvement in car wheels is, the connexion and intersection of the convex and rim plates by independent and interlacing branches, substantially in the manner and for the purposes set forth."

2. For an *Improvement in Slat Machines for Window Blinds;* Elihu R. Benson, Warsaw, New York.

Claim.—"What I claim is, 1st, The arrangement for moving the hollow augers back and forth in performing the milling of both ends of the slats at once, combined with the slide, operated substantially in the manner and for the purposes specified. 2d, The manner of feeding the dressing and sticking portions of the machine, by means of the slide, operated substantially as specified. 3d, The method herein described, of sticking the wires by means of hooks and drivers, operated substantially as herein specified."

3. For an *Improvement in Corn Planters;* Gardner A. Bruce, Mechanicsburgh, Ill.

Claim.—"I do not claim the dropping slide, nor any peculiar arrangement thereof, as they are used in many drills, and are constructed and operated substantially as the one herein shown; but what I claim is, the employment or use of the balance beams with the rods attached to them, and operating as described, for the purpose of properly adjusting the seed in the holes of the dropping slide, and also to prevent the clogging of the same, as described."

4. For an *Improvement in Machines for Topping Cotton in the Field;* A. A. Dickson, Griffin, Georgia.

Claim.—"Having described the nature and operation of my invention, what I claim is, the employment of two sets of cutters, and one set being adjustable, and revolving in a horizontal direction, and the other being fixed, and revolving in a vertical direction, and both sets being set in operation through the action of the driving or propelling wheel, in any manner equivalent to that described, and for the purpose specified."

5. For an *Improved Apparatus for Polishing Anvils;* Mark Fisher and John H. Norris, Trenton, New Jersey.

Claim.—"What we claim is, suspending the anvil in the sliding and vibrating frame, and arranging it in respect to the polishing part of the apparatus, and operating them, as fully described."

6. For an *Improvement in Machines for Rubbing and Polishing Leather;* Joseph F. Flanders, Newburyport, Massachusetts.

Claim.—"What I claim is, 1st, The employment of a vertical shaft with arms extending from its sides, for the purpose of carrying the tools and their accompanying mechanism, in combination with a plane surface horizontal table, for the purpose described. 2d, I claim the joint tool holder, either with or without the springs, constructed substantially as described. 3d, I claim the arrangement of a movable table, permitting of an endwise and at the same time downward motion, constructed in the manner described, or the equivalent thereof, for the purpose described. I do not claim to be the inventor of a rotating shaft with arms extending from its sides, carrying tools for the purpose of dressing leather, only when used in a vertical position, and in combination with a plane surface horizontal table; nor do I claim the springs operating to produce the pressure on leather; nor do I claim to be the inventor of the sliding bolts."

7. For an *Improved Machine for Grinding Plough Castings;* Joshua Gibbs, Canton, O.

Claim.—"What I claim is, the carriage upon which the casting is fastened, with the weight and grooved stand, upon which the carriage is moved, arranged, and operated, as described."

8. For an *Improvement in Ploughs;* Robert A. Graham, New Paris, Ohio.

Claim.—"What I claim is, 1st, The screw bolt, or its equivalent, for setting out or in the rear edge of the mould board, with respect to the land side, acting in combination with the bolts, which being tightened, attach to each other the mould board, sheath, and lipped or flanched share, as described, and which bolts being temporarily relaxed, permit the vibration of the mould board about the bolt, without interrupting the continuity of ploughing surface, or disconnecting the several parts. 2d, The shifting or adjusting socket attachment of the beam to the sheath, in combination with the dovetail and adjustable connexion of the rear end of the beam to the helve, or equivalent devices, so as to vary the direction of the draft of the plough to suit the requirement of a change in the flare of the mould board, and other objects, as explained."

9. For an *Improvement in Maize Husking Machines;* Thomas C. Hargreaves, Schenectady, New York.

Claim.—"What I claim is, 1st, The application of the chisel or chisels, and cutter or cutters, in combination with the gate or gates, and operating by gearing, or other means, substantially as described. 2d, I claim the construction of the circular plate, or its equivalent, as described, in combination with the cutters for severing the cob, and the elbow lever for discharging the husks, as set forth. 3d, I claim the combination of cam, lever, and spring, with stud for holding the circular plate stationary whilst removing the ear and husk from the machine, or any other equivalent, as specified."

10. For an *Improvement in Annunciators for Hotels;* Wm. Horsfall, City of N. York.

Claim.—"What I claim is, the manner shown and described, of constructing and arranging the index plates, or in combination with the alarm and its necessary attachments, so that each plate can be operated, and its number exposed to view, and also the alarm sounded instantly after, by simply employing a rod having a tripping arm, in the manner and for the purpose specified. I also claim the manner described and shown, of throwing the index plates back to their proper position by means of the eccentric rod, in combination with the peculiar construction and arrangement of the said index plates, the eccentric being operated in any manner equivalent to that shown and described."

11. For an *Improvement in Straw Cutters;* Richard Ketcham, Seneca Castle, N. York.

Claim.—"What I claim is, the method described, of hanging and operating the cutter by means of its pivoted attachment to the slide, in combination with the guide rod, the latter being made adjustable by the helical spring at the top, or other equivalent device, substantially as and for the purposes set forth. I further claim, in combination with the inclined reciprocating knife, and simultaneously with the descent thereof, giving to the gauge a lateral curvilinear or oblique downward action away from the rear end of the knife towards the front end thereof, and below the cutting edge of the table, substantially as shown and described, whereby the straw is restrained from being crowded towards the back end of the knife by the inclination of the cut, and a free escape is established for the cut particles to pass off, as specified."

12. For an *Improvement in Car Wheels;* Zadock H. Mann, Newport, Kentucky.

Claim.—"I claim the construction, as described, of a cast iron railroad car and locomotive wheel, whose web or portion connecting the hub and rim, consists at the hub of broad radiating plates in the plane of the axis, whence, turning alternately to the right and to the left, they contract in the direction parallel with the axis, and expand proportionally in the direction of revolution; those of each alternate set uniting as they approach their respective margins of the rim concave, so as to form flanches having openings left for each intermediate plate on the other side, forming a braced and counter-braced wheel, possessing the requisite lateral stability and continued support at the rim, together with adequate provision for the strain arising from shrinkage, &c. And this I claim, whether the said web be formed in a cyma reversa curve, as described, or in any way substantially equivalent."

13. For an *Improvement in Smut Machines;* Benjamin Rutter and Henry Rowzer, Piqua, Ohio.

Claim.—"We claim the narrowing of the spout near the grain discharge, in combination with the curved passages, which receive and discharge at their respective apertures the light grain and trash taken from the grain discharge aperture."

14. For an *Improvement in Rotary Steam Engines;* John C. fr. Salomon, Washington, District of Columbia.

Claim.—"What I claim is, the combination of the elliptic wheel and its cylinder, with the sliding abutments or stops, arranged in such manner that a continuous propelling force may be communicated to the wheel without exposing it to unequal pressure of the fluid on opposite sides of its axis, throughout the entire revolution in either direction, substantially as specified. I further claim, in combination with the revolving wheel or piston, the arrangement and operation of the valves described, in such a manner that as the effective propelling area of the piston surface exposed to the impelling fluid between either two abutments diminishes, the wheel is assisted by an increasing area of piston surface exposed to the action of the fluid on the opposite sides of the abutments, as specified; whereby the propelling fluid may be worked expansively without impairing the uniformity of the active power of the engine, as set forth."

15. For an *Improvement in Cooking Ranges;* George S. G. Spence, Boston, Mass.

Claim.—"I claim as my invention the arrangement of the openings and damper, with respect to the arrangement of smoke flues above and below them, substantially as above specified, by which combined arrangement I am enabled, when desirable, by the direct draft, to cause the heat to pass under the back half of the bottom of the oven, up alongside the entire back of the oven, and up the rear portion of the left side of the oven, and over the top of the oven into the chimney, instead of carrying it entirely around the oven, as set forth. I do not claim to so combine a hot air flue with a fire place, and a flue extending directly therefrom to and underneath an oven and up the rear end of such oven, that such hot air flue shall pass only in contact with the back of the fire place and with the oven flue; but what I do claim is, the above described arrangement of the fireplace, boiling chamber, and smoke flues leading under the oven, and in rear of the back thereof, in combination with the peculiar arrangement of the hot air chambers, and whereby the fire place and oven flues are not only made to heat the air flues, but the bottom plate of the boiling chamber is also made to impart heat thereto, and the back as well as the front of the upright air flue is also heated by the smoke flue through which it passes, as specified."

16. For an *Improvement in Burglar Alarms;* Edward Brown, Rindge, New Hampshire, Assignor to Josiah Norcross, M. D., South Reading, Massachusetts.

Claim.—"I do not claim the combination of an alarm clock with a lamp-lighting apparatus, they being so applied that on an alarm being sounded by the clock works, they shall set free the separate machinery by which the lamp and friction match are rotated, the latter being carried against a roughened surface for the purpose of igniting it. In my alarm apparatus, the spring which moves the match holder not only performs the operation of moving such match holder, but it elevates the bell and its spring until the slide is brought up against the shelf, which taking place, the accumulated force on the bell causes the bell to vibrate and sound the alarm. I therefore claim the improvement of so connecting the match holder and the bell spring with the slide, that the spring of the slide on being set free by the opening of the door, shall not only elevate the match holder, but set the bell in motion, so as to cause the alarm to be sounded by it, in manner as specified."

17. For an *Improvement in Machines for Paring Apples;* Ephraim L. Pratt, Worcester, Assignor to James Sargent and Dan. P. Foster, Shelburn, Massachusetts.

"The machine having been constructed and completed as described, an apple is placed upon the fork, and the shaft turned by the crank, the worm turns the gear, with the shaft and gear, which drives the sector gear which carries the shaft and rod, so as to move the knife over the surface of the apple as it is turned by the fork, and pare it completely, except a small space between and around the fork. By the time the apple is completely pared, except the portion above mentioned, the wheel will have turned so that the blank space will be against the sector gear, so as to release it and allow the spring to turn the sector gear back to place the knife in the position it is represented, when the apple pared may be removed, and another put in its place and pared, as above described. I contem-

plate that the construction of my machine may be varied without departing from the principles of my invention."

Claim.—"What I claim in the above described machine for paring apples and other vegetables is, hanging or connecting the block which carries the knife to the rod which carries said block, so that the block and knife can vibrate in one or either direction, (by means substantially such as are herein described, or their equivalents,) so as to allow the knife to vibrate and accommodate itself to any irregularity in the surface of the apple or vegetable pared, substantially as described."

18. For an *Improved Hydraulic Ram;* Joseph C. Strode, East Bradford, Pennsylvania.

Claim.—"What I claim is, the application of the brachystochrone curve to the conduit pipes of hydraulic rams, in the manner and for the purposes set forth."

19. For an *Improved Turbine Water Wheel;* Henry Vandewater, Albany, New York.

Claim.—"What I claim is, the manner or method of regulating the discharge openings of the buckets from the outside, in combination with the central gate, for adapting the wheel to varying heads of water, and to the nature and amount of work to be done by it, consisting of the circular gate, constructed, arranged, and operated with the wheel, substantially as in the manner set forth."

20. For *Improvements in Air Engines;* James A. Woodbury, Winchester, and Joshua Merrill and George Patten, Boston, Massachusetts; patented in England, Jan. 5, 1853.

Claim.—"What we claim is, supplying the air pump from a receiver into which air has been condensed by a hand pump, auxiliary engine, or otherwise, (the hand pump or auxiliary engine being used for the purpose of charging and sustaining a uniform pressure in the receiver from which the air pump is supplied,) when the same is done in combination with a second receiver, into which the air is to be still more compressed and maintained at a uniform pressure, or nearly so, by the application of heat to the air on its passage to the working cylinder, all in the manner and for the purposes above set forth."

21. For an *Improved Stop Cock;* Elizur Wright, Boston, Massachusetts.

Claim.—"I do not claim the application of rubber or soft elastic substances as packing to valves; nor do I claim the ball shaped valve, the ball having been previously used to answer as a valve in peculiar circumstances different from those to which my invention applies; what I claim is, the combination of a ball with an elastic cylindrical ring seat, constructed with or without a wire, as described, for the purpose of forming a valve."

22. For an *Improved Throttle Valve Arrangement;* John E. Anderson, City of N. York.

"The simplest way of constructing the valve seat is to cast the cylinders with a short length of pipe, which will constitute a valve box. The only fitting up required will then be the boring of the cylinders, and the turning of the valve to fit them. The slots may be so narrow that they would close and open to their full width with the smallest desired amount of motion. On account of the small amount of motion that is necessary, the wear of the valves will be very slight. If slots are made on opposite sides of the valves and cylinders, they will be perfectly balanced in all directions, one balancing the other, and the steam acting equally on all sides of each; thus the friction on every part of the wearing surface will be the same, and the movement being the same, the wear will be equal."

Claim.—"What I claim is, the combination, to serve the purpose of a throttle valve or regulator, of two hollow cylindrical valves, connected with a lever on opposite sides of its fulcrum, and having slotted openings, corresponding with similar openings in the cylindrical valve seats; the several openings being arranged in the manner as substantially set forth."

23. For an *Improvement in Magazine Guns;* Edmund H. Graham, Biddeford, Mass.

"The operation of the gun is as follows: by depressing the trigger guard, the charge receiver and magazine are simultaneously rotated, the former far enough for the reception of the charges of powder and ball, or shot, and the latter so as to carry a load of such powder and ball or shot, directly into line with the connecting passages of the barrel. By turning the gun a little, a load will pass from the magazine into the charge receiver. This done, the trigger guard is to be moved up to the stock, and while this takes place, it rotates back the charge receiver so as to close the passages that convey the load through the side of the barrel, and bring the nipple or cone passage into communication with the pow-

der in the charge receiver. On pulling the trigger, a discharge of the gun will take place. This operation may be repeated while there are loads in the magazine."

Claim.—"I do not claim a rotary magazine connected with the barrel of a fire arm, such being in common use in repeating guns; nor do I claim to combine a magazine for powder, balls, and priming, with a hollow cylinder or tube made to encompass and revolve on a barrel, while the barrel is provided with holes or passages to receive the load from the magazine when the latter is turned around on it into a suitable position; nor do I claim the combination of a rotary charge receiver (placed within the barrel or breech of a gun,) and a stationary loading magazine affixed on the barrel or breech; but what I do claim is, the arrangement of the series of ball chambers, &c., and the series of powder chambers, &c., in concentric circles, and on the side of the gun barrel, and out of the sight range, and so as not only to revolve and work against a common plate affixed to the side of the gun, but to operate in conjunction with a rotary charge receiver placed within the barrel, as specified; such arrangement of the magazine of chambers not only causing the powder of the charges to be kept in separate chambers, so as to lessen the danger of accidents, but causing the magazine to be so arranged as to be out of range of sight in taking aim. And I also claim to so combine the percussion hammer or cock, the rotary charge receiver. and the rotary magazine, with the trigger guard, that by the movement of the said guard away from the stock, they may be simultaneously put in motion, and the hammer brought up to full cock, as specified."

24. For an *Improvement in Plough Beams;* Levi B. Griffith, Honeybrook, Penna.

Claim.—"What I claim is, constructing a plough beam of four round iron rods, centre piece, and clamps, in combination as described, the rods being of uniform size from end to end, curved to the shape specified, and welded together at the places designated, the counter piece and rods being held firmly in their position by the clamps, the whole being constructed as described."

25. For an *Improvement in Self-Acting Switches;* Archibald S. Littlefield, Portland, Maine.

Claim.—"I am aware that the relative position of the switch with the main track or turnout, or sliding track, has been changed by the action of a cam or mechanism attached to the car or cars, as well as by devices attached to the locomotive in various ways. I therefore do not claim such, but I base my invention and claim on the above described method of shifting the switch, viz: by the action of the flanches of the wheels on depresser bars, and other mechanism applied to the main and turnout tracks and the switch, substantially as specified. I do not claim depresser bars; but I claim the combination of the transverse rocker lever, the shaft, the toothed sector, and the rock, as applied to the switch and the main and turn-out tracks, and made to operate as specified. And in combination with the toothed sector, I claim the locking plate provided with notches, as specified, the same being for the purpose of locking the switch, in manner as described."

26. For an *Improved Cutter for Boring Wheel Hubs;* Leonard S. Maring, Westport, Massachusetts.

Claim.—"The combining the backer with the shaft and the knife, for the purpose set forth."

27. For an *Improvement in Files and Rasps;* Hiram Powers, now residing in Florence, Italy.

"The nature of my invention consists in forming perforations or throats to the fin, feather, or cutting surfaces of rasps or files, for the purpose of allowing said rasps or files to clear themselves of the material cut away by them, and to prevent their filling or choking, by admitting or allowing the particles to pass through said perforations or throats."

Claim.—"What I claim is, the forming of perforations or throats to the cutting edges of files or rasps, for allowing the particles cut away to pass through, and to prevent the instrument from clogging or choking, substantially as described."

28. For an *Improved Machine for Turning Spiral Mouldings;* Philip P. Ruger, City of New York.

"My invention consists in the combination of rotating tools, the axes of motion of which are perpendicular to the axes of motion of the article to be cut, so as to cut any variety of pattern in the cross section with very bold and complex under cutting, in any style desired."

Claim.—"What I claim is, combining with a rotary progressive motion of the article to

be cut, a series of cutters placed around the article to be cut, of any desired configuration, or varieties of configuration, to form and complete the pattern upon the article; said cutters being made to revolve in a stationary frame perpendicular to the axis of motion of the article to be wrought, either in a radial line, or somewhat inclined thereto, so as to form the desired figure and undercut to any extent desired."

29. For an *Improvement in Gold Washers;* John H. Ward, Sonora, California.

"The nature of my invention consists in the method of arranging the several parts, one over the other, and operating them, so arranged, as to perform the whole washing and separating process, in a compact machine, occupying very little space, easily transported, and at great saving of water."

Claim.—"I do not claim washing or agitating the mass or earthy matter containing the gold, in a tub, box, or cistern; nor do I claim simply washing the earth without a current of water: but what I do claim is, the employment of the reciprocating perforated trough, armed with cutters or breakers, in combination with the sieve and decanting trough, arranged beneath the reciprocating trough; and in combination with said reciprocating trough, I claim the percolating plate, arranged above the same."

30. For an *Improvement in Propellers;* Charles T. P. Ware, City of New York.

"I construct my blades of india rubber, in any of its various forms of preparation, or of any other elastic or pliant material, in combination with elastic ribs, or with inflexible parts."

Claim.—"What I claim is, a propeller having one or more blades, the front and rear edges of which are of unequal stiffness; the blade or blades thus constructed being arranged upon an oscillatory shaft, and operating substantially as set forth."

31. For an *Improved Guide for Doweling Felloes for Wheels;* William C. Dean, Jacksonville, New York.

Claim.—"What I claim is, the combination and arrangement of the tube, guides, and set screw, for the purpose of holding the wood and guiding the bit, as described and set forth."

32. For an *Improved Daguerreotype Plate Holder;* Marshall Finley, Canandaigua, N. Y.

Claim.—"I do not claim holding daguerreotype plates to be buffed by the outward pressure of spiral springs against the turned edges of the plates; but what I do claim is, constructing a solid daguerreotype plate holder or block, having fastenings at each corner made by spiral springs, in combination with tightening bolts, having concave heads, into which the bent or turned corners of the plate to be buffed are hooked, so as to admit of a uniform buffing, as set forth."

33. For an *Improved Machine for Jointing Staves;* Charles B. Hutchinson, Syracuse, New York.

Claim.—"What I claim is, 1st, The use of the circular guide-ways, in combination with the movable piers or bearings, and the cams or levers, or other suitable means of moving the same simultaneously and equally along said circular guide-ways, so that the saws or other cutters may be instantaneously adjusted for any required width of stave, without stopping their motion, or changing their direction towards a constant central point. 2d, The use of the wing or leaf guage, in combination with the index moving over a graduated arc or dial, both moving in connexion with the saws, so as to indicate at a glance the width between the saws, and to guide the operator in setting the stave on its bed plate, and adjusting the saws. 3d, The mode of jointing staves to any required bilge and level, without bending or springing them by rotating them endwise in a plane perpendicular to their width, between saws or other cutters, so inclined as to give the correct level, whether adjustable or not; said rotation being upon a circle, or other proper curve, such as to present each part of the stave to the action of the inclined cutters at the precise point or height requisite to give it its exact proportionate width or bilge; the rotation being obtained by means of a central arch piece moving over rollers about a constant centre of motion, substantially as described, or by other equivalent means."

34. For an *Improvement in Processes for Dechlorinating Bleached Fabrics;* J. Augustus Roth, Philadelphia, Pennsylvania.

Claim.—"What I claim is, the process of removing chlorine from fabrics by means of the solution herein described, and denominated anti-chlorine, or by means of any other solution substantially the same, in the manner and for the purpose as described."

35. For an *Improvement in Looms for Weaving Coach Lace;* James H. Murrill, Richmond, Virginia.

Claim.—"What I claim is, 1st, The revolving pliers, constructed as described, and operated by the spindle, whirl, connecting rod, lever, and cams, in combination with the finger, constructed and operated as specified, wedge, and cylindrical stand, by which combination the needles, upon which the pile is formed, are seized, removed from the finished portion of the fabric, carried up, inserted under the colored warp selected by the jacquard for the figure, and released, substantially as specified. 2d, The construction of the stationary shuttle box, as described, having its front sustained by, and movable about the projecting rod, so as to operate the ungearing apparatus upon a miss-throw of the shuttle, in the manner specified. 3d, The combination of the sliding reed with the stationary shuttle box, when constructed and operating substantially as specified. 4th, The combination of the notched wheel, rock shaft, and arms, with the lever, spring, shaft, rod, and bar, arranged substantially as described, for operating the ungearing apparatus in the manner specified, when a derangement occurs in the machinery operating the needles. 5th, The springs, as arranged upon, in combination with the rods, by means of which the strain upon the eyes of the harness is diminished, substantially as specified."

36. For an *Improvement in Cooking Ranges;* John P. Hayes, Boston, Massachusetts.

Claim.—"What I claim is, 1st, The receiving or box flue, formed under the oven, in the manner above described, and for the purpose specified. 2d, I claim so combining a movable oven sliding upon a stationary bottom through which the hot air is admitted, with the smoke flues about the same, as to cause the smoke, &c., to pass about and over the oven, and the hot air to pass into the same, as described."

37. For an *Improvement in Machines for Punching Metal;* Ozias J. Davie and Thomas W. Stephens, Erie, Pennsylvania.

Claim.—"What we claim is, disconnecting the punch stock from the machine automatically at each operation of the punch, by means of the weighted lever and key, or their equivalents, for the purpose of affording the operator time to place his sheets, without regard to the motions of the machine, when by a slight movement of the ball or lever upon the rising of the punch, the connexion can be again formed, substantially as described."

38. For an *Improvement in Camphine Lamps;* John Newell, Boston, Massachusetts.

Claim.—"What I claim is, 1st, The silvering of the perforated metal, or brass, copper, or iron wire gauze, used in safety lamps and cans, or other vessels, designed to prevent explosions from the vapor of camphine, burning fluid, &c., the silvering being applied for the purpose of preventing the corrosion of the metal or wire gauze, as above described, by the most economical process. 2d, The introduction of perforations, as above described, in the caps of lamps used for burning camphine, burning fluid, &c., so small as not to admit the communication of flame through them, for the purpose of allowing the escape of the vapor formed within the lamp, from camphine, burning fluid, &c., and thereby preventing the bursting of the lamps by the pressure of the vapor. I do not claim the use of any perforations in lamps for burning camphine, burning fluid, &c., except such as are constructed so as to prevent the passage of flame on the principle of Sir Humphrey Davy, relative to the passage of flame through perforated metal."

39. For an *Improved Planing Machine;* Richard H. Pindell, Fayette County, Assignor to Wm. J. Shurman, Washington, Kentucky.

"The nature of my invention consists in planing boards with reciprocating knives, having uniform and continuous feed motion, the planes cutting on their backward as well as forward stroke; possessing, at the same time, a partial reciprocating rotary motion about an axis perpendicular to the surface planed."

Claim.—"What I claim is, 1st, The combination of the differential velocities of feed motion, and the motion of the knives, that is, when their relative speed is such that the knives shall cut on their back as well as on their forward motion, in the manner and for the purposes substantially set forth. 2d, Giving to straight-edged planes for dressing lumber, a partial reciprocating rotary motion about their own centre, for the purposes and in any manner substantially the same as described and shown in the drawings. 3d, I claim a yielding pressure roller, placed in front of the stocks, in combination with an endless planing bed, for the purpose of feeding planks, &c., to the plane, operated in any manner substantially the same as before set forth."

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40. For an *Improvement in Ploughs;* Cornelius R. Brinckerhoff, Batavia, New York.

"The nature of my invention consists in attaching to any common plough, two wheels of different sizes and shapes, the small one to run upon the land, the large one to run in the bottom of the furrow with its side against the land, by a movable iron axle passing through holes in the bottom part of two common cast iron lifters or supporters, which are attached to the beam, one on each side, which have the effect of holding the plough perfectly steady, and regulating both the depth and width of the furrow slice."

Claim.—"What I claim is, 1st, Combining with the plough beam between the plough and the clevis, two wheels, one on each side of the beam, and of different diameters, the one resting in the furrow and the other on the land, for the purposes set forth and described. 2d, I also claim making the tread of the furrow wheel narrow, for the purposes described. 3d, I also claim making the said wheels, especially the furrow wheel, adjustable in the direction of its axis, for the purpose of adapting its position to furrows of different widths. 4th, I also claim making the furrow wheel beveling outward on the side which presses against the land, as above described, and for the purposes herein before set forth. 5th, I also claim making the small wheel adjustable vertically with reference to the shaft and the large wheel, as described."

41. For an *Improvement in Hullers of Grass Seed;* Henry P. Byram, Louisville, Ky.

"The nature of my invention consists in removing the chaff or hulls from the seed by pressing and holding it up against an emery or sand wheel, by an unvarying pressure, whether the hopper be more or less full."

Claim.—"What I claim is, in combination with the rubbing or scouring wheel, the method of feeding up and holding against the said wheel the seed to be cleaned, by a pressure which is unvarying, whether the hopper be full or not, substantially as described."

42. For a *Detachable Lining for the Fire Boxes of Steam Boilers;* John B. Collan, Reading, Pennsylvania.

Claim.—"What I claim is, a detachable lining for the sides and ends of fire boxes of steam boilers, consisting of one or more tubes connected with the adjacent water space by means of hollow bolts, or their equivalent, substantially as herein set forth, so as to admit of the ready removal and replacement of the tubes."

43. For an *Improvement in Ash Pans for Locomotive Engines;* Gilman Davis, Roxbury, Massachusetts.

Claim.—"What I claim is, the taking in of the air in front of the ash pan, and introducing it into the fire box in a direction opposite to the furnace doors, to protect the fireman from the back-lash of the fire when said doors are opened, by means substantially such as described."

44. For an *Apparatus for opening and closing Gates;* Samuel G. Dugdale, Richmond, Indiana.

"The nature of said improvement consists in hanging the gate in such a manner, that by moving the bottom of the gate in an oblique direction from and to the post, I cause the gate to open, close, and fasten, by its own weight, and assume a perfectly plumb and level position, both when open and closed, and always opening from the horses, allowing the vehicle to pass through without stopping. It consists, further, in the arrangement of levers in such a manner, that by the vehicle passing over the vertical lever, causes the gate to open, and at the same time changes the opposite lever, so that the vehicle, on passing over it, closes the gate, and draws the levers to their original position. The gate arranged upon this plan may be opened and closed the same as any other swinging gate now in use, without operating the machinery."

Claim.—"What I claim is, 1st, Opening, closing, fastening, and unfastening the gate, by moving the bottom of the gate in an oblique direction from and to the post upon which it is hung, as specified. 2d, The use of the pendulous and vertical levers and arms, in combination with the hinges of the gate, the whole being operated and arranged in the manner and for the purpose as set forth."

45. For an *Improvement in covering Iron with Gutta Percha;* Charles Goodyear, New Haven, Conn.

Claim.—"What I claim is, the art or method of coating articles composed wholly or

partly of metal, with compounds of caoutchouc or gutta percha, and subjecting the same to a high degree of artificial heat, or the process of vulcanization, substantially as specified."

46. For an *Improvement in Hill-side Ploughs;* Nathan Harrison and John W. H. Metcalf, Ridgeville, Va.

"The nature of our improvement or invention consists in its superior strength, durability, and simplicity, being less complicated, and not so liable to get out of order as other hill-side ploughs, and the construction being so simple that any country smith can make it, the entire plough being of wrought iron, except the mould board, which is cast."

Claim.—"We claim curving downward and inward the beam in the rear part, so as to cause it to support the rotary part of the plough, which it performs in combination with the standard, in the manner and for the purposes set forth."

47. For an *Improvement in Driving Circular Saws;* Joseph Harris, Jr., Boston, Mass.

"The nature of my invention consists in hanging the arbor, with a pulley and saw thereon, in a frame, the axis of the arbor frame being parallel to the axis of the large driving pulley, and within its circumference, with springs attached to the said frame, the tendency of which is to swing the arbor frame in such a manner as to bring the surfaces of the pulleys together, and a few pounds applied by the springs will cause many pounds pressure on the surfaces of the pulleys."

Claim.—"I do not claim driving pulleys by their surfaces coming in contact with each other, that method having before been used; but what I claim is, 1st, The method of hanging the arbor frame on journals for its axis, each side of the driving pulley bringing the axes of the arbor frame within the circumference of the driving pulley, or on a line passing through the driving pulley, in such a manner and at such an angle with a tangent to the driving pulley, that the act of feeding the stuff to the saw or cutter will press the arbor pulley against the driving pulley, in the manner and for the purpose described. 2d, I claim hanging the arbor frame on such an angle, that the act of feeding the stuff to the cutter will press the arbor pulley against the driving pulley, in combination with a spiral spring, or its equivalent, for holding the arbor pulley firmly against the driving pulley, as described."

48. For an *Improvement in the attachment of a Harrow to a Land Roller;* Daniel Hill, Bartonia, Indiana.

Claim.—"What I claim is, the arrangement and mode of attaching the harrow to the forward axle of a roller, in the manner and for the purpose set forth."

49. For an *Improvement in Cob and Stalk Cutters;* Thomas B. Jones, Carloville, Ala.

Claim.—"What I claim is, the combination of the feeding trough, its gauge disk, the tube, and its gauge ring, with the knives, whereby the same knife will at the same time cut fodder coarse and cobs fine, and thereby improve the quality of the product as feed for animals."

50. For an *Improvement in Winnowers of Grain;* Henry M. Keller, Newark, Ohio.

Claim.—"What I claim is, the trap door, in combination with the screen, arranged and operated in the manner and for the purpose set forth."

51. For an *Improvement in Straw Cutters;* J. J. Parker, Marietta, Ohio.

Claim.—"What I claim is, operating both the reciprocating gate and the feeding rake, by means of the compound spring pitman, substantially as set forth."

52. For an *Improvement in Rotary Root Digging Cultivators;* Samuel Snow, Fayetteville, and Alexander Hine, La Fayette, New York.

Claim.—"What we claim is, the combination of the two toothed cylinders with the receiving box, all being arranged and suspended on an adjustable frame, in the manner and for the purpose set forth."

53. For an *Improvement in Shaking Shoes of Winnowers;* Jacob L. Van Valkenburgh, Ogdensburgh, New York.

Claim.—"What I claim is, not the use of sieves in cleaning grain, but the communication of a reciprocating rotating motion to the sieves or separators, and also the construction of the machine, in the manner substantially as above set forth, for separating grain from cockle and other impurities."

54. For an *Improvement in Treating Metals while in the Molten State;* Horace W. Woodruff, Watertown, New York.

Claim.—"What I claim is, treating metals while in the molten state to expel impurities therefrom, by immersing therein some porous or cellular non-conducting substance or substances containing liquid matter, substantially as specified."

55. For an *Improvement in Vegetable Cutters;* D. Henshaw Whittemore, Chicopee Falls, Massachusetts.

Claim.—"What I claim is, the combination of the long and short knives on the periphery of the cylinder with the hopper, arranged as described."

56. For an *Improvement in Washing Machines;* H. G. Robertson, Greenville, Tenn.

"The nature of my invention consists in constructing the machine with a rocking frame having a hinged slatted washing board, arranged inclining, in each of its ends, and having suitable cords for holding the clothes while being washed, arranged under its bottom, in combination with the box or tub, in the sides of which the bearings of the rock shaft are secured and allowed to turn. The said tub being divided into two compartments, so that white and brown clothes may be washed separately in the same machine and at the same time; and the bottom of the tub being slatted so as to work in combination with the slatted wash boards, and effectually operate upon the clothes in each compartment alternately, and remove all dirt from them with the greatest ease and despatch; the rocking of the shaft and the consequent up and down motions of the slatted wash boards being the only operation requisite, and this can be done by a child. The said alternate motions of the rocking frame causing either of the slatted washing boards having the clothes tied under them, to descend and strike parallelly the horizontal bottom and the hot suds, which latter are forced through the pores of the clothes by the two slatted surfaces coming together, and thereby caused to separate the dirt from them, the air which the clothes catches in descending aiding materially the entrance of the steam or suds through the pores of the clothes, and the effectual operation of the same."

Claim.—"What I claim is, the employment of the double chambered slatted bottom tub, in combination with the vibrating or rocking frame, constructed with two hinged slatted wash boards, which have cords passing under the bottom of them for holding the clothes against their bottoms while washing. The said boards being made movable or swinging, so that the clothes can be easily laid on the cords, and they also being set in such a position that they and the clothes will always be caused to strike parallelly the slatted bottom and the hot suds in the tub, and force the latter through the pores of the clothes, and cause them to be washed clean; the whole being constructed and arranged and operated in the manner described."

57. For *Improvements in Griddles;* Banford Gilbert, Pittsburgh, Pennsylvania.

Claim.—"What I claim is, the constructing of griddles of two pieces, separated by flanches, furnished with openings to admit of the passage of cool air between the upper and lower pieces of the griddle, which openings may be closed at pleasure, substantially as described."

58. For *Improvements in Oscillating Engines;* Alexander B. Latta, Cincinnati, Ohio.

"The nature of this invention and improvement consists in so arranging the valve chambers, outside of barring or trunnion; by this arrangement the eccentric rod is allowed to pass across the centre of the trunnion, thereby communicating with the slide bar, to which the valves are attached, and thereby giving independent motion to the valves, regardless of the oscillating of the cylinder. The steam pipe is so formed as not to interfere with the eccentric rod; the sliding bar has a curved slot where the wrist pin is attached, which may be used to shorten the throw of valves, but it is not an essential appendage; the steam enters the pipe, and then enters the chest, thence to cylinder, does its work, and then into the passage which leads to the trunnion, thence around the cylinder and out of the trunnion. The mode of operating this engine is the same as any other engine; the adjustments are to be set in the same way as a stationary cylinder; the setting of the valves in every way the same."

Claim.—"What I claim is, the mode of arranging the valve chambers outside of the barring or trunnion on which the cylinder oscillates, in such manner as to allow the wrist pin of the eccentric rod to move equally across the centre of the trunnion, and moving equally above and below, and thereby giving motion to the valve or valves, by said eccentric, independently of the oscillating of the cylinder. I also claim the sliding bar or bars

to which the eccentric is attached, and passing up the whole length of the valve chambers to the end or ends, as the case may be, and attached to the valve rods, thereby giving motion to the valves. I claim this arrangement, as set forth by drawings, or their mechanical equivalents."

59. For an *Improvement in Life Boats;* Yelland Foreman, City of New York.

Claim.—"What I claim is, constructing the body of my life boat wholly of metallic tubes, brazed, or similarly united throughout, thus affording a water tight and solid metallic connexion, and mutual bracing of every part, as shown, whereby are attained the objects explained, in a compact and generally advantageous manner. I further claim, in combination with such boat, the detachable tubular seat, as described."

60. For an *Improved Valve Motion of Oscillating Engines;* William Stephens, Pittston, Pennsylvania.

Claim.—"What I claim is, 1st, The combined arrangement of the slide valve and guide, which assists the oscillation of the engine in producing, and directs the motion of the said valve, substantially as described, to wit: the valve being arranged to work transversely to the cylinder, and the guide being in the form of part of a helix or screw, concentric to the axis of the cylinder's oscillation, and receiving an arm or cross-head attached directly to the rod or stem of the valve, whereby the intermediate mechanism usually employed is dispensed with. 2d, Giving the valve the necessary or desired lead, by means of the adjustable sliding lining pieces which line the sides of the guide, and are furnished with projecting or rising parts, which will give the necessary lead in working the engine in either direction, as set forth."

61. For a *Machine for Cutting Binders' Boards;* John A. Elder, Westbrook, Assignor to John E. Coffin, Portland, Maine.

Claim.—"What I claim is, 1st, The arrangement of machinery for cutting pasteboard into strips, and those strips a given length, at the same time. 2d, The arrangement of the rocker shaft, rolls, and shears, for the purpose above described. 3d, I also claim the series of shears, or its equivalent, for the purpose described."

62. For an *Improvement in Cultivating Ploughs;* L. M. Whitman, Assignor to Samuel G. Wise, Weedsport, New York.

Claim.—"What I claim is, the employment of the long inclined spring wings, secured at their front ends to the share and main standard, and turning upon the pin, in combination with the mechanical contrivance shown and described, for expanding and contracting the wings, or setting them more perpendicular and nearer together, for the purpose of throwing more pulverized soil against or up to the hills, or setting them less inclined to the horizontal plane, and further apart, for the purpose of allowing the pulverized soil, weeds, &c., to pass over them into the broad open spaces in the centre; the said wings in either case cutting up the weeds and pulverizing the soil, the same as fully set forth."

MECHANICS, PHYSICS, AND CHEMISTRY.

Experimental Investigation of Table-Moving. By M. Faraday.*

The object which I had in view in this inquiry was not to satisfy myself, for my conclusion had been formed already on the evidence of those who had turned tables,—but that I might be enabled to give a strong opinion founded on facts, to the many who applied to me for it. Yet, the proof which I sought for, and the method followed in the inquiry, were precisely of the same nature as those which I should adopt in any other physical investigation. The parties with whom I have worked were very honorable, very clear in their intentions, successful table movers, very desirous of succeeding in establishing the existence of a peculiar power, thoroughly candid, and very effectual. It is with me a clear point that the

* From the London Athenæum, July, 1853.

table moves when the parties, though they strongly wish it, do not intend, and do not believe that they move it by ordinary mechanical power. They say, the table draws their hands; that it moves first, and they have to follow it,—that sometimes it even moves from under their hands. With some the table will move to the right or left according as they wish or will it,—with others the direction of the first motion is uncertain:—but all agree that the table moves the hands, and not the hands the table. Though I believe the parties do not intend to move the table, but obtain the result by a *quasi* involuntary action,—still I had no doubt of the influence of expectation upon their minds, and through that upon the success or failure of their efforts. The first point, therefore, was, to remove all objections due to expectation, having relation to the substances which I might desire to use:—so, plates of the most different bodies, electrically speaking,—namely, sand-paper, millboard, glue, glass, moist clay, tinfoil, cardboard, gutta percha, vulcanized rubber, wood, &c.,—were made into a bundle and placed on a table under the hands of a turner. The table turned. Other bundles of other plates were submitted to different persons at other times,—and the tables turned. Henceforth, therefore, these substances may be used in the construction of apparatus. Neither during their use nor at other times could the slightest trace of electrical or magnetic effects be obtained. At the same trials it was readily ascertained that one person could produce the effect; and that the motion was not necessarily circular, but might be in a straight line. No form of experiment or mode of observation that I could devise gave me the slightest indication of any peculiar natural force. No attractions, or repulsions, or signs of tangential power, appeared,—nor any thing which could be referred to other than the mere mechanical pressure exerted inadvertently by the turner. I therefore proceeded to analyze this pressure, or that part of it exerted in the horizontal direction:—doing so, in the first instance, unawares to the party. A soft cement, consisting of wax and turpentine, or wax and pomatum, was prepared. Four or five pieces of smooth slippery cardboard were attached one over the other by little pellets of the cement, and the lower of these to a piece of sand-paper resting on the table; the edges of these sheets overlapped slightly, and on the under surface a pencil line was drawn over the laps so as to indicate position. The upper cardboard was larger than the rest, so as to cover the whole from sight. Then, the table turner placed the hands upon the upper card,—and we waited for the result. Now, the cement was strong enough to offer considerable resistance to mechanical motion, and also to retain the cards in any new position which they might acquire,—and yet weak enough to give way slowly to a continued force. When at last the tables, cards, and hands all moved to the left together, and so a true result was obtained, I took up the pack. On examination, it was easy to see by the displacement of the parts of the line, that the hand had moved further than the table, and that the latter had lagged behind; that the hand, in fact, had pushed the upper card to the left, and that the under cards and the table had followed and been dragged by it. In other similar cases when the table had not moved, still the upper card was found to have moved, showing that the hand had carried it in the expected direction. It was evident, therefore, that the table had not drawn the hand and person

round, nor had it moved simultaneously with the hand. The hand had left all things under it behind, and the table evidently tended continually to keep the hand back.

The next step was, to arrange an index, which should show whether the table moved first, or the hand moved before the table, or both moved or remained at rest together. At first this was done by placing an upright pin fixed on a leaden foot upon the table, and using that as the fulcrum of a light lever. The latter was made of a slip of foolscap paper, and the short arm, about ½ of an inch in length, was attached to a pin proceeding from the edge of a slipping card placed on the table, and prepared to receive the hands of the table turner. The other arm, of 11½ inches long, served for the index of motion. A coin laid on the table marked the normal position of the card and index. At first the slipping card was attached to the table by the soft cement, and the index was either screened from the turner, or the latter looked away: then, before the table moved, the index showed that the hand was giving a resultant pressure in the expected direction. The effect was never carried far enough to move the table, for the motion of the index corrected the judgment of the experimenter, who became aware that, inadvertently, a side force had been exerted. The card was now set free from the table, *i. e.*, the cement now removed. This, of course, could not interfere with any of the results expected by the table turner,—for both the bundle of plates spoken of and single cards had been freely moved on the table before; but now that the index was there, witnessing to the eye, and through it to the mind, of the table turner, not the slightest tendency to motion either of the card or of the table occurred. Indeed, whether the card was left free or attached to the table, all motion or tendency to motion was gone. In one particular case there was relative motion between the table and the hands: I believe that the hands moved in one direction; the table turner was persuaded that the table moved from under the hand in the other direction:—a gauge, standing upon the floor, and pointing to the table, was therefore set up on that and some future occasions,—and then, neither motion of the hand nor of the table occurred.

A more perfect level apparatus was then constructed in the following manner:—Two thin boards, 9½ inches by 7 inches, were provided; a board, 9 by 5 inches, was glued to the middle of the underside of one of these, (to be called the table-board,) so as to raise the edges free from the table; being placed on the table, near and parallel to its side, an upright pin was fixed close to the further edge of the board, at the middle, to serve as the fulcrum for the indicating lever. Then, four glass rods, 7 inches long and ¼ in diameter, were placed as rollers on different parts of this table-board, and the upper board placed on them; the rods permitted any required amount of pressure on the boards, with a free motion of the upper on the lower to the right and left. At the part corresponding to the pin in the lower board, a piece was cut out of the upper board, and a pin attached there, which, being bent downwards, entered the hole in the end of the short arm of the index lever: this part of the lever was of cardboard; the indicating prolongation was a straight hay-stalk 15 inches long. In order to restrain the motion of the upper board on the lower, two vulcanized rubber rings were passed round both, at the parts

not resting on the table: these, whilst they tied the boards together, acted also as springs,—and whilst they allowed the first feeblest tendency to motion to be seen by the index, exerted before the upper board had moved a quarter of an inch sufficient power in pulling the upper board back from either side, to resist a long lateral action of the hand. All being thus arranged, except that the lever was away,—the two boards were tied together with string, running parallel to the vulcanized rubber springs, so as to be immovable in relation to each other. They were then placed on the table, and a table turner sat down to them:—the table very shortly moved in due order, showing that the apparatus offered no impediment to the action. A like apparatus, with metal rollers, produced the same result under the hands of another person. The index was now put into its place and the string loosened, so that the springs should come into play. It was soon seen, with the party that could will the motion in either direction, (from whom the index was purposely hidden,) that the hands were gradually creeping up in the direction before agreed upon, though the party certainly thought they were pressing downwards only. When shown that it was so, they were truly surprised; but when they lifted up their hands, and immediately saw the index return to its normal position, they were convinced. When they looked at the index, and could see for themselves whether they were pressing truly downwards, or obliquely so as to produce a resultant in the right or left handed direction, then such an effect never took place. Several tried, for a long while together, and with the best will in the world; but no motion, right or left, of the table, or hand, or anything else, occurred.—[A passage from the letter in the *Times* is worth reproducing here,—as illustrating in other words the value of this method of self-conviction.—"The result," says Prof. Faraday, "was, that when the parties saw the index it remained very steady; when it was hidden from them, or they looked away from it, it wavered about, though they believed that they always pressed directly downwards; and, when the table did not move, there was still a resultant of hand force in the direction in which it was wished the table should move, which, however, was exercised quite unwittingly by the party operating. This resultant it is which, in the course of the waiting time, while the fingers and hands become stiff, numb, and insensible by continued pressure, grows up to an amount sufficient to move the table or the substances pressed upon. But the most valuable effect of this test-apparatus (which was afterwards made more perfect and independent of the table) is the corrective power it possesses over the mind of the table turner. As soon as the index is placed before the most earnest, and they perceive—as in my presence they have always done—that it tells truly whether they are pressing downwards only or obliquely, then all effects of table turning cease, even though the parties persevere, earnestly desiring motion, till they become weary and worn out. No prompting or checking of the hands is needed—*the power is gone;* and this only because the parties are made conscious of what they are really doing mechanically, and so are unable unwittingly to deceive themselves. I know that some may say that it is the cardboard next the fingers which moves first, and that *it* both drags the table and also the table turner with it. All I have to reply is, that the cardboard may in practice be reduced to a thin sheet

of paper weighing only a few grains, or to a piece of goldbeaters' skin, or even the end of the lever, and (in principle) to the very cuticle of the fingers itself. Then the results that follow are too absurd to be admitted: the table becomes an incumbrance, and a person holding out the fingers in the air, either naked or tipped with goldbeaters' skin or cardboard, ought to be drawn about the room, &c.; but I refrain from considering imaginary yet consequent results which have nothing philosophical or real in them."]

Another form of index was applied thus :—a circular hole was cut in the middle of the upper board, and a piece of cartridge paper pasted under it on the lower surface of the board; a thin slice of cork was fixed on the upper surface of the lower board corresponding to the cartridge paper; the interval between them might be a quarter of an inch or less. A needle was fixed into the end of one of the index hay-stalks, and when all was in place the needle point was passed through the cartridge paper and pressed slightly into the cork beneath, so as to stand upright: then any motion of the hand or hand-board was instantly rendered evident by the deflexion of the perpendicular hay-stalk to the right or left.

I think the apparatus I have described may be useful to many who really wish to know the truth of nature, and would prefer that truth to a mistaken conclusion: desired, perhaps, only because it seems to be new or strange. Persons do not know how difficult it is to press directly downward, or in any given direction against a fixed obstacle: or even to *know only* whether they are doing so or not; unless they have some indicator, which, by visible motion or otherwise, shall instruct them: and this is more especially the case when the muscles of the fingers and hand have been cramped and rendered either tingling, or insensible, or cold, by long continued pressure. If a finger be pressed constantly into the corner of a window frame for ten minutes or more, and then, continuing the pressure, the mind be directed to judge whether the force at a given moment is all horizontal, or all downward, or how much is in one direction and how much in the other, it will find great difficulty in deciding; and will at last become altogether uncertain: at least such is my case. I know that a similar result occurs with others; for I have had two boards arranged, separated, not by rollers, but by plugs of vulcanized rubber, and with the vertical index: when a person with his hands on the upper board is requested to press only downwards, and the index is hidden from his sight, it moves to the right, to the left, to him and from him, and in all horizontal directions; so utterly unable is he strictly to fulfil his intention without a visible and correcting indicator. Now, such is the use of the instrument with the horizontal index and rollers: the mind is instructed, and the involuntary or *quasi* involuntary motion is checked in the commencement, and therefore never rises up to the degree needful to move the table, or even permanently the index itself. No one can suppose that looking at the index can in any way interfere with the transfer of electricity or any other power from the hand to the board under it or to the table. If the board tends to move, it may do so, the index does not confine it; and if the table tends to move, there is no reason why it should not. If both were influenced by any power to move together, they may do so,—as

they did indeed when the apparatus was tied, and the mind and muscles left unwatched and unchecked.

I must bring this long description to a close. I am a little ashamed of it, for I think, in the present age, and in this part of the world, it ought not to have been required. Nevertheless, I hope it may be useful. There are many whom I do not expect to convince; but I may be allowed to say that I cannot undertake to answer such objections as may be made. I state my own convictions as an experimental philosopher, and find it no more necessary to enter into controversy on this point than on any other in science, as the nature of matter, or inertia, or the magnetization of light, on which I may differ from others. The world will decide sooner or later in all such cases, and I have no doubt very soon and correctly in the present instance. Those who may wish to see the particular construction of the test apparatus which I have employed, may have the opportunity at Mr. Newman's, 122, Regent Street. Further I may say, I have sought earnestly for cases of lifting by attraction, and indications of attraction in any form, but have gained no traces of effects. Finally, I beg to direct attention to the discourse delivered by Dr. Carpenter at the Royal Institution on the 12th of March, 1852, entitled 'On the influence of Suggestion in modifying and directing Muscular Movement, independently of Volition':—which, especially in the latter part, should be considered in reference to table moving by all who are interested in the subject.

Royal Institution, June 27.

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*Art-Manufacture.**

(Continued from page 278.)

The study of the productions of a past age and of the beautiful forms of nature has certainly done much for Art of late,—and has laid the foundation from which much more will arise; but the servile imitation which has been unfortunately far more prevalent has filled our shops and houses with productions which call up a smile on the face of the man of taste, whether Englishman or foreigner. In one place we find a row of sphinxes supported by something between an obelisk and a milestone, guarding the entrances of a row of houses in the simplest modern English style. In another we are condemned to clean our shoes upon a scraper composed of two anomalous looking figures, whose wings clasp each other and supply the edge by means of which the mud is to be removed from the sole. On one table we see octagonal jugs which look as though they had been made out of a number of spare pieces, and call up the idea rather of carpentry than of pottery;—on another—probably devised to hold that very unromantic liquid with which we temper the crudity of our tea and coffee—the chivalric temperament of the designer comes forth in great force; around the top edge is an elegant Gothic fret-work, which might have been borrowed from the screen of one of our most beautiful cathedrals. Below, the same ornament is reproduced in an inverted position. Between these two specimens of happy adaptation we find a knight armed *cap-à-pie*,

* From the London Athenæum, May, 1853.

mounted on a fiery charger, galloping at full speed round the sharply curved side of the earthenware, his horse's hoofs being very appropriately placed in close connexion with the sharp points of the lower ornament referred to, and upon which he seems to be galloping. The knight points his lance in the direction of his horse's nose, and the weapon being of considerable length, reaches about one-third round the circumference of the jug. The full effect of the design is not apparent until we glance at the other side of this specimen of Art-manufacture, when we find that another mounted knight is galloping along the top of the corresponding spikes,—and that his lance, describing nearly another third of the circumference, is pointed curvilinearly at the other gentleman on horseback —whom he will certainly not catch sight of until he shall have run him through the body, or been run through by him. We have a brazen Rachel drawing not water, but *ink*, if anything, from an elegant well, shaded by a palm tree in the same hard metal. A young Swiss maiden carries an elegant milk-pail on her head, not intended to hold milk, but a taper. We have Paul and Virginia under a palm tree, which supports a glass for flowers amongst its branches. Apollo dancing and at the same time supporting a glass epergne twice his own size, suggests the not very elegant idea of a drunken porter staggering from Covent Garden with a large basket of flowers. We have candles stuck into elegant cast tulips or China-asters,—gas rushing forth from the head of Minerva,—lamp-stands formed of leaves and flowers, which rest upside down with their tips upon the table, and thus support the superincumbent weight, after the fashion of the clown who stands upon his hands and supports his fellow acrobat with his feet in the air. Such are some of the results that flow from the imitative system, by which the ornaments of a past age are imported and crudely mixed up with objects wherewith they do not harmonize:—or of that system in which the graceful forms of Nature, instead of being *adapted* as ornaments to objects of utility, are applied without taste or judgment, and often degraded to unseemly purposes.

These solecisms are, it is true, to be found in the productions of other countries besides this; but we must admit, that England commits a great many more than her due share of them. It would be very extraordinary if it were not so, considering the very small amount of attention which we have bestowed on Art-education. Dr. Waagen, whose position as Director of the Museum of Fine Arts in his own country, gives weight to his words, says:—"From the first introduction of the Fine Arts in this country to the present day, they have received little or no notice from the Government as such: their encouragement, like that of many other important objects, has been left to the public. The foundation of the Royal Academy itself is of comparatively recent date, and it is self supported: The collection of sculpture and antiquities in the British Museum, and that of painting at the National Gallery, have been formed only within the last half-century, and many of their most valuable treasures are donations of bequests of private individuals. Before the building of the new Houses of Parliament, the distinguished artists of this country had rarely been employed by the Government on works of a monumental character, and such commissions were, from their nature, not the objects of private munificence. This is one principal cause why in the English

school of painting and sculpture, no true monumental style has been as yet formed. Again, it was only in the year 1836 that the Schools of Design were formed; institutions by means of which the Fine Arts have exerted a most beneficial influence on the vast productive energy of Great Britain. Much improvement in every branch of industry has been accomplished by means of these schools, but it must be acknowledged that in many kinds of manufacture the English productions, both in regard to their form and their color, show far less taste than those of other nations. Both the Government and the nation, however, are now becoming conscious of the great importance of Art, not only in its monumental character, but in its relation to industry. The vast range of comparison which the Exhibition has afforded, by the juxtaposition of the products of so many nations, has directed the English mind to more enlightened views; and, from the energy of the national character and institutions, these newly awakened ideas may ultimately prove of the greatest benefit in regard to both the Fine Arts and the manufactures of the country."

Of his own country the Doctor says:—"Since the year 1815 great efforts have been made by the successive monarchs and administrations of Prussia to encourage the Fine Arts in that country. Museums and other buildings of a similar character have been erected; sculptors, and more recently painters, have been employed in the execution of monumental works, and the cultivation of all those manufactures on which Art can exercise any influence has been greatly promoted by the foundation of the 'Institution for Trades' (*Gewerbe Institut*). . . . That these efforts have led to the happiest results, has been proved by the Exhibition which has furnished to Prussia a long-desired opportunity of showing what progress has there been made."

Of France, he says:—"The French have been distinguished for many generations by the great encouragement that they have bestowed, as a nation, on the Fine Arts. The French Government under every change in its outward form has not failed to regard Art as one of the most important instruments of civilization; and recognising its great and beneficial influence on the manufactures of the country, has, by the most liberal grants, placed it in a peculiar manner under the protection of the State. Millions of the national revenue have, in consequence, been devoted to the erection of great public edifices, and to the purchase of the best works of native artists. . . . . In consequence of this encouragement on the part of the Government, the French School of Art has been most fertile in its productions; many branches of Art have been brought to a rare degree of perfection, and the diffusion of an improved taste has exercised a most beneficial influence on a variety of trades and handicrafts. By these means Paris has become an universal market, not only for the Fine Arts themselves, but for most of the branches of industry to which they are in any way allied."

Lastly, in speaking of the United States of America, the Doctor says:—"The American States, which in the course of a few generations have established so vast a scheme of municipal and political institutions, have attained to great perfection in many branches of industry, and are now beginning to turn their attention to the sciences, and also to those arts which minister to the spiritual rather than to the animal wants of man,

and which have for their high purpose the investigation of truth, and the expression of beauty through form. All who have truly at heart the advancement of civilization, and regard it as the common good of mankind, must surely rejoice at the success which has attended this new movement of the American mind."

Mr. Redgrave, like every well informed man who has taken up the subject, speaks in like terms of the steps that have been taken in other countries in relation to the education of the eye and hand of the people. He says:—"In estimating the progress of this country in ornament and in Art-workmanship, as compared with the Continental nations, there is one circumstance that must enter largely into consideration. In France, Germany, Italy, and Belgium, in addition to schools for teaching ornamental art, royal and national manufactories have been established for many years. In these no necessary expense is spared to bring to perfection the fabrics wrought in them, both as to the highest excellence of workmanship and materials, and to their embellishment by ornamental design. The best painters, sculpters, and designers, as well as men of the most scientific acquirements in botany, mineralogy, and chemistry, are among their professors; and, the works being carried on at the public expense for the attainment of excellence, the cost of repeated failures is unheeded. In such establishments a band of skilled workmen must of necessity be trained, to the ultimate benefit of the private manufacturers, and those difficulties which science had found means of surmounting, or those new processes and new materials which it had brought to light, be spread abroad for the common advantage of all. Moreover, the sight of excellence and of the products of skilled workmanship is one of the greatest stimulants to further exertion, since all Art and all Manufacture arrive at perfection by gradual advances on past labors. The workman who sees the results of the skill which has produced such works in china and porcelain as were exhibited in the Sèvres room or in the hall of the Zollverein, must feel this stimulus in no mean degree. When it is remembered what one single artist did in this country for the same manufacture, and how greatly Wedgwood and his workmen were indebted to Flaxman, we can well feel what influence a band of artists of like ability, exercising their talents to improve every department of the manufacture, and of these a continued succession, would be likely to exercise over the taste and skill of those in contact with them. Nor is this all: the excellence of one fabric awakens a desire for like excellence in others, and calls forth the same spirit of emulation. It surely cannot be doubted, therefore, that the Continental nations, and more especially France, in this manufacture, and through it in many others, have been largely benefited by such institutions; besides the amount of national reputation obtained by them from the display of the choice works which are therein produced." In referring to some French paper-hangings, he says:—they exhibit "the superiority of the French working artist. The men who carry out the designer's inventions in France must themselves have a large share of skill and art-knowledge to be able to prepare the design for the manufacturer's processes with the ability so evident in the works just remarked upon." This superiority of the French over the English art-workmen is remarked in connexion with many branches of industry, and especially

in the treatment of the human figure. In wood carving, for instance, the English are *certainly* amongst the best of imitative artists; but there is a marked deficiency apparent whenever they attempt to represent the human figure, which can never be successfully rendered on the merely imitative principle, as flowers, fruits, and other objects may. It is requisite that the workmen should have some knowledge of the structure of the body to enable him to render with effect any design containing the human form with which he may be entrusted.

The Official Report of the Jury concludes with the following passage:—"The Jury of Class Thirty having brought their labors to a conclusion, cannot refrain from expressing their hope that steps may be taken for rendering the Great Exhibition as useful after it has ceased to be, as it has proved gratifying and instructive in the course of its short existence. It is the wish to see these hopes realized that impels the Jury, even at the risk of overstepping the strict limits of their functions, to submit with great deference their views on this point to the Royal Commissioners. The foundation of a permanent industrial museum in the heart of the metropolis of trade and industry, seems to the Jury the logical and practical consequence of this Exhibition. It is in the Crystal Palace that the great truth has been impressed upon us, that art and taste are henceforth to be considered as elements of industry and trade, of scarcely less importance than the most powerful machinery. It seems also natural that this museum should in the first instance consist of the objects to which the several juries have called public attention as happy types and models for imitation. While such a museum on the one hand would be a lasting depository of industry and of the arts—it would on the other serve as the best and easiest standard of comparison by which human ingenuity might mark its progress on the opening ten years hence of a new Great Exhibition. It would serve alike as a guide and as a beacon."

These decided opinions and recommendations of a jury which included the names of foreigners having a large experience of the sort of institutions recommended, must be looked on as raising to a high place among the topics of the day the subject of supplying artistic education to the working and other classes.

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*An Account of the Means taken to Raise a Sunken Floor of a Warehouse at Mill Lane, Tooley Street.**

In the year 1849, Alderman Humphrey built a stack of warehouses at the bottom of Mill lane, Tooley street, from designs prepared for him by his architects, Messrs. Allen, Snooke, and Stock. That portion of the work which forms the substruction was carried on somewhat irregularly, and was directed in great measure by the Alderman himself. The builders were Messrs. William Cubitt and Company, of Gray's Inn road. The foundations of the piers and front wall, against the street, were put in entirely under the Alderman's own direction, so that, whatever has taken place from defective construction reflects in no manner either on his

*From the London Builder, No. 539.

architects or his builders. Some time since, we described briefly, after a personal visit, the failure in the foundation here, and the means adopted to raise the floors. On the 16th ult. Mr. I' Anson laid the particulars of the case before the Institute of Architects, and we add a portion of his statement:—

The building consists of seven stories, including the basement. The roof is a queen post roof, of about 60 feet span; the height of the top story, from the floor to the under side of the tie-beam, is 10 feet; the walls are 1½ brick thick in the recesses, and 2 bricks thick in the piers. The upper floor is constructed with wooden girders, having a bearing from centre to centre of the iron posts of 15 feet; the girders are 13 inches square; the joists, 12 inches apart, 12 inches by 3; and the bearing between the girders is 11 feet 6½ inches, or from centre to centre of the posts 12 feet 7½ inches; the girders are supported by iron posts, to which I shall hereafter refer, and their ends rest on stone templates. The height of the story next beneath the topmost floor, from the top of the floor to the under side of the joist above, is 8 feet 10 inches; the walls on this floor are 2 bricks thick in the recesses, and 2½ in the piers. This floor is constructed as a fire-proof floor, with arches 1 brick thick, in cement, springing with a rise of 12 inches and a span of 12 feet 7 inches, from iron girders, or springers; there is a layer of concrete over these arches, on which the floor surface is formed with asphalte; the abutment of the arches is stiffened by tie bolts running longitudinally through the building, one in the centre of each bay, between the iron story posts. The construction of the floor next but one to the topmost floor is similar to that of the topmost floor; the walls are 2½ bricks thick, and the height of the story, from the top of the floor to the under side of the joists, is 8 feet 9 inches. The floor next but two to the topmost floor is fire-proof, being formed of brick arches built in cement with a thickness of concrete, covered by an asphalte flooring, as already described for the floor next the topmost floor; the walls are 3 bricks thick. The height of this floor, from the surface of the asphalte to the under side of the joists above, is 8 feet 9 inches. The floor next but three to the topmost floor, in ordinary parlance the first floor, is of timber construction, and similar to that of the topmost floor, except that the spaces between the joists are filled in with concrete, supported on a layer of slates fixed between the joists by wooden fillets. The height of this floor, from the surface of the floor to the under side of the iron springer, is 8 feet 2 inches, but under the centre of the arch 9 feet 2 inches; the walls are 4 bricks thick in the recesses and 4½ in the piers. The ground floor is paved with slate, bedded on concrete, resting in the arches of the basement story, which arches are 9 inches thick, built in cement, and have a span of about 9 feet 4 inches, and a rise of 13 inches. This floor is 9 feet 10 inches to the under side of the girders, and 10 feet 10 inches to the under side of the joists; the walls of the same thickness as in the floor above. The basement floor is paved with stone, and is 8 feet 10 inches high under the centre of the arch.

The iron posts supporting the floors increase in size from the top of the building downwards; the caps are cast with the posts, and have a spread of 3 feet. The diameter of the upper story posts (or rather the width of the web) is 8 inches, and the metal web is 1 inch thick, and the centre

of the post is, I believe, hollow. The diameter of the lower story posts is 11 inches, the metal of the web is 1¼ inch thick. The warehouse is thus divided into four horizontal compartments, which are, it is presumed, effectually fire-proof, and the compartment between the ground floor and first floor is further made more secure by the quasi fire-proof construction of concrete laid between the joists,—a principle which Alderman Humphrey has carried out to a much greater extent in some of his other warehouses. The total area of each floor is about 6656 feet, and the total cubical contents of each fire-proof compartment, including the thickness of the timber floor, is 133,000 cubic feet. The communication between the several fire-proof compartments is at present, and is intended permanently to be, by means of a staircase external to the building, but between the two compartments comprised between the fire-proof arches, it is by the usual internal ladder from floor to floor.

Before its completion the warehouse began to show some evidences of settlement, which, as the loading was applied, greatly increased until the settlement of the story posts reached as much, in some cases, as 10 inches, one of the first symptoms being the crushing of the arches springing from the piers in the basement.

With the exception of the great defect of putting all the floors out of level, the building suffered no further damage than that the several brick arches, and particularly those in the basement floor, were all more or less fractured, and some of the stone templates in the wall were also split.

The simple and efficacious means which have been used to rectify this defect is the subject to which I now call attention. Simple and comparatively easy as the operation may appear, I know of nothing of its kind which has been more successful; and the experiment having been conducted on a scale of some magnitude, and with such satisfactory results, I have thought it might not be devoid of interest.

The warehouse having been relieved of all its contents, except on the upper floor, which was loaded all the time, the first operation was to remove the pavement of the basement, and to shore up the warehouse on that floor. For this purpose four cast iron girders, each capable of bearing a weight of 150 tons, were inserted through the piers under the springing of the arches, and these were effectually shored up by timber shores. The next step was to sink down to the foundations of the piers. Here the concrete was found defective and soft, but the great error seems to have been in not excavating the ground down to the gravel, and placing the original concrete on it. In restoring the work this was, however, done. The first concrete was removed, and the ground below having been excavated, fresh concrete of Thames ballast and stone lime was put in, resting on the gravel. The thickness of the new concrete was from 5 to 7 feet. The lower parts of the original brick piers, which were built in mortar, were removed, sometimes in one and sometimes in two at a time, the upper parts being carried during the underpinning by the iron girders, and the piers were rebuilt with brick-work in cement. These parts having been made secure, new arches of three half-brick rims were introduced under the original arches, springing from pier to pier, and on which the skewback which carried the floor arches of the ground floor was cut. These arches were considerably crippled, and the springing line

now shows by its sagging, as it were, towards the middle of the building, how considerable a settlement has taken place, but it is now only in this part of the building that it can be observed. The floor arches were repaired and made good. The concrete covering was also partially removed, and the whole of the slate paving of the ground floor. The concrete having been made good and brought to a level, the slate pavement was relaid. The foundation having then been perfectly secured, centres were fitted to the two end bays of all the brick arches above the basement, which was shored up, and one course of bricks was removed all along the crown of the arches which were shored; against the side walls of the warehouse the arches were cut through so as to leave them quite free and clear of the walls, and the brick work round the ends of the iron springers was cut away so as to leave the ends free, and all the bolts securing caps to the wooden girders were screwed out and left loose. Stout uprights were then placed in the centre between each post, from the basement arch to the underside of the iron springer of the first fire proof floor; and twenty-eight screw jacks of various forms and power having been procured, were fixed as close as they could be conveniently to the sides of the posts, and other strong uprights were placed above the jacks up to the underside of the girders on the top floor. A man having been placed to look out on every floor, the screwing commenced, by which at every effort the floors were raised from $\frac{1}{16}$th to $\frac{1}{8}$th of an inch.

The raising was thus effected of all the floors above the first floor, and gradually, as they rose, iron wedges were applied under the caps of the first floor, and also over the uprights between the posts. This operation of screwing having been gradually carried on a little at a time, at intervals of a day or so, until the floors were raised as high as was considered safe, the screw jacks were removed, and upright shores were placed against the posts, which were then left loose, and by the aid of two small jacks they were each got up, and stone and iron bases placed under them and well wedged up. When the whole had been made secure and firm, the brick arches were repaired, and made good. The whole operation of screwing up, including the preparing for it, and making good after it, occupied two months. The jacks were worked two at a time, and there were sometimes ten men to one jack. The whole work has now been most effectually carried out, and there are few traces (except the sunk line of the springing of the basement arches) to indicate the great settlement which took place. The restoration has not, however, been carried out with mathematical precision, and it has been thought necessary to introduce some iron wedges between the iron caps and springers; and to make doubly sure, the wooden girders have had an extra camber given to them, and are blocked up with wooden blocks on the iron caps.

The warehouse has now been carefully and fully tested, and there is no further evidence of settlement or giving in any direction.

One thing which is particularly instructive in this partial failure, is the fact that the foundation of the flank wall, which was built at the same time as the foundations for the story posts, and is carried down to the same level, has not sunk. Another instance of the necessity of making the foundation for story posts and columns stronger than the continuous foundation of a wall, once came under my own observation, in the case

of the enlargement of a warehouse, where the flank wall, which had stood perfectly well, having been removed, and the warehouse enlarged by building another flank wall, removed further out by one bay, a range of posts was built on the foundation of the old wall, every one of which failed.

The cost of Alderman Humphrey's warehouse was about 12,000*l.* in all, or about 190*l.* to the square superficial. The cost of the restoration was about 1000*l.*

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*Twenty-third Meeting of the British Association for the Advancement of Science.**

Introductory Address on General Improvements in Mechanical Science during the past year. By W. Fairbairn.—The first subject noticed by Mr. Fairbairn was Ericsson's Caloric Engine, from which so much had been expected. It was constructed, he said, on the same principle as the air engine of Dr. Stirling, invented ten years ago—the chief difference being, that the air in Ericsson's engine is passed through wire gauze to take up the heat, instead of through plates of iron. The great objection to the engine appeared to be that two-thirds of the power were wasted in passing the air through the gauze; and though it might be premature to pronounce an opinion before the results of the improvements lately effected were known, yet if so much of the power was required for taking up the heat, Mr. Fairbairn could not but think it must prove a wasteful expenditure of fuel.—The improvements that during the last year had been made in the application of the screw propeller were opening a new era in the history of our war and mercantile navy, of which the recent review at Spithead might be considered an indication. We were now in a state of transition between the paddle and the screw, and he had no doubt that in the progress of time great improvements would be made in the construction of the engines, and in their applicability to the work, which would materially economize space and power in our steam vessels.—Mr. Fairbairn next alluded to the construction of an immense steam vessel, which had been undertaken by Mr. Brunel and Mr. Scott Russell, of such vast dimensions that it would stretch over two of the largest waves of the Atlantic, and would thus obtain a steadiness of motion which would be a preventive against sea-sickness. This mammoth steamer is to be 680 feet long, with a breadth of beam of 83 feet, and a depth of 58 feet. The combined power of the engines would be that of 2600 horses. The ship is to be built of iron, with a double bottom of cellular construction, reaching six feet above the water line, and with a double deck, the upper and the lower parts being connected together on the principle of the Britannia tubular bridge, so that the ship will be a complete beam. It would thus possess the strength of that form of construction, and not be liable to "hogg," or break its back, as had been the case with other ships of great length. The double bottom would be a means of increased safety in other ways, for if by any accident the outer shell were broken, the inner one would prove effectual to keep out the water. As an addi-

* From the London Athenæum, September, 1853.

tional security, however, it was divided into ten water-tight compartments. The ship would be propelled by paddles and by a screw, which would be worked by separate sets of engines, so that if any accident occurred to the machinery of one, the other would be in reserve. He said he had no doubt that if properly constructed this ship would answer the expectations entertained of its capabilities and strength, and that it would form, when completed, the most extensive work of naval architecture that had ever been constructed.—The next subject to which Mr. Fairbairn adverted was the improvements making in the locomotive department of railways, particularly to an engine constructed for the southern division of the North Western Railway, from the designs of Mr. M'Connell, which was the most powerful locomotive that had yet been made for the narrow gauge. The peculiarity of construction consisted in the great length given to the fire box, in which the greatest amount of steam is always generated, and in the comparative shortness of the tubes, which were only half the usual length. The steam generated by this boiler was sufficient for any engine of 700 horse power. The engine was intended for an express train that would complete the distance from London to Birmingham in two hours. In manufacturing machinery there had also been great activity and progress during the past year, and it was gratifying, Mr. Fairbairn observed, to find accompanying this improvement in machinery a most prosperous condition in the working classes engaged in those manufactures—a prosperity which had never been equalled within his experience. He attributed this prosperous state of things to the combined operations of improvements in machinery and the removal of commercial restrictions. The improvement which he more especially noticed was that of a new combing machine of French invention, applicable alike to cotton, to flax, and to wool. It combs the fibre instead of carding it, a number of small combs being applied in succession to the cotton or flax, by which means a much finer yarn can be produced from the same material than is possible by the former processes. As evidence of the present activity and enterprise in manufacturing industry, Mr. Fairbairn mentioned the erection of a mammoth alpaca woolen manufactory, by Mr. Salt, of Saltaire, near Bradford, which was 550 feet long, 50 feet wide, and six stories high, besides offices, warehouses, and various other buildings connected with it. Their steam engines to drive the machinery would be equal to 1200 horse power, and the factory would employ upwards of 3000 hands. The cost of the whole would be upwards of 300,000*l*., and the enterprise was that of a single individual. Mr. Fairbairn concluded his *résumé* of manufacturing progress by noticing the improvements introduced by Prof. Crace Calvert, of Manchester, in the process of smelting iron by previously removing the sulphurous vapor from coal and coke. The results had proved most satisfactory, the strength of the iron produced by this process being about 40 per cent. greater than that made in the ordinary way.

Report of the Committee appointed in 1852 *to prepare a Memorial to the Hon. East India Company on the Means of Cooling Air in Tropical Climates.* By W. J. Macquorn Rankine.—In the absence of Mr. Rankine, one of the Secretaries read the Report, which was founded on experiments with apparatus invented by Prof. Smyth, described by him at a

previous meeting of the Association. The principle of the invention consists in cooling the air by expansion. The air at the temperature of the atmosphere is first compressed in a bell receiver, and the heat generated by this compression is lowered by passing the air through a number of tubes immersed in water, by which means it acquires in its compressed state the normal temperature of the atmosphere, say 90° of Fahrenheit. The air then passes into another inverted bell receiver, where it is expanded to the ordinary pressure of the atmosphere, and during this expansion it absorbs so much heat that the temperature is reduced to 60°. It is then admitted into the room to be ventilated. The compression of the air during the experiments in the first cylinder was equal to $3\frac{2}{10}$ ins. of mercury per square inch above the pressure of the atmosphere, and the refrigerator exposed a cooling surface of 1100 square feet, which was considered sufficient to reduce the temperature of the air in passing through the tubes to that of the atmosphere, viz: 90°. The Report stated that by means of this apparatus, 66,000 cubic feet of air per hour might be cooled from 90° to 60°, by a steam engine of one horse power, which is required to raise and depress the bell receiver. The advantage of cooling the air by mechanical means instead of by evaporation, was stated to be the avoidance of aqueous vapor with which the air is injuriously charged by the evaporating process.

On Reaping Machinery. By A. Crosskill.—Mr. Crosskill gave an historical account of the invention of reaping machines, from their use by the Romans and Gauls to the present time; with a view to show that though reaping machines had not been brought prominently to notice before the Great Exhibition, such implements had long since been invented, and that the reaping machines of Messrs. M'Cormack and Hussey were constructed on the same principles as those which had been previously made in this country. Among other English inventions of reaping machines, he mentioned one by Mr. Smith, of Deanston, in 1812, which from time to time underwent improvements, and in 1835 it worked very successfully at the meeting of the Highland Agricultural Society. After that trial it was laid aside, as British farmers did not encourage, and, during the redundance of labor, did not want such machines. In 1822, Mr. Ogle, of Remington, near Alnwick, invented a reaping machine, which appears to have served as a model for Mr. M'Cormack, as his machine is in almost every particular the same as Mr. Ogle's, a description of which was published in 1826. The same circumstances which prevented the adoption of Mr. Smith's reaping machine also caused Mr. Ogle's to be laid aside; though in America, where labor is scarce and the stalk of the corn more slender and dry, and therefore better adapted for the action of mechanical cutters, M'Cormack's reaper was soon in extensive demand. It was stated by Mr. Crosskill that about 2000 of M'Cormack's machines are annually sold in the United States, and that Hussey's is in nearly equal request in that country. The celebrity acquired by those machines in the Great Exhibition induced Mr. Bell, of Scotland, who had gained a prize in 1829 from the Highland Agricultural Society for a reaping machine, to bring his invention again into the field. In 1852 he contested with Mr. Hussey at the meeting of the Highland Society at Perth, and carried away the prize; and his reaping machine had proved victorious

on several subsequent trials. It was to this invention that Mr. Crosskill particularly directed the attention of the Section. It differs in several essential points from those of M'Cormack and Hussey. In the first place, the machine is propelled before the horses, which are harnessed to a pole in the centre of the machine, and not on one side; in the next place, the cutters act like large double edged scissors, which clip the corn as the machine is propelled into it; and a further advantage is, that it gathers the corn after it is cut without requiring a man to rake it off, which is necessary in the two other machines. The arrangement of the self-acting gatherer consists of an endless band of canvas, on to which the corn falls as it is cut, and it is then thrown on one side by a continuous motion of the canvas as the machine advances. With this machine, Mr. Crosskill stated, one acre and a half of corn per hour may be cut with two horses and one man to drive them.

In the discussion which ensued, Mr. Samuelson, the maker of M'Cormack's machines, admitted Bell's reapers cut the corn better than M'Cormack's; and that the saving of the hard work required from a man in gathering the corn was an important advantage; but the draft of M'Cormack's machines, he said, is lighter, and they are less costly. It was stated that the cost of Mr. Bell's reaper is double that of Mr. M'Cormack's or Mr. Hussey's, the one being 40*l*., the other 20*l*. Mr. Crosskill stated, in reply to questions respecting the difficulties encountered in the use of reaping machines when corn is laid, that there is no difficulty in cutting and gathering laid corn, if the machines meet it inclined towards them, so that it may fall on the gathering board as it is cut. Models of the three machines were exhibited.

The Rise, Progress, and Present Position of Steam Navigation in Hull. By J. Oldham.—In this paper Mr. Oldham took a retrospective survey of the application of steam power to the propulsion of ships, with a view to prove that Hull has taken a prominent part in the introduction and improvement of the invention. In 1787 experiments were made in Hull, by Messrs. Furnace & Ashton, which resulted in the construction of a steamboat worked with paddles, that attracted the attention of the Prince Regent, by whom the boat was purchased; but it was soon after maliciously burnt. In 1814, the first steamboat on the Humber was established to run from Hull to Gainsborough. It was called the *Caledonia*, and it accomplished, under favorable circumstances of the tide, fourteen miles an hour. The first sea-going steamboat sent from Hull was in 1821; and it was supposed to be the first steamboat that plied on the east coast of England. The sea-going steamers that are now connected with the port of Hull have an aggregate tonnage of 9139, and 2749 horse power. The tonnage of the river-boats is 2218, with 1135 horse power. The other steamboats coming to Hull have a burthen of 5909 tons and 2236 horse power. There are altogether 80 steamboats trading with Hull, of which number 15 are propelled by the screw.

A discussion arose on the respective merits of the inventors of steam navigation, and the priority of their inventions; in which discussion Mr. Fairbairn, Mr. Bayley, and Mr. Thompson took part. Mr. Fairbairn said he saw the *Caledonia* enter South Shields, and that it was the first steamboat in the North after Henry Bell's on the Clyde. Bell, it was stated,

got the idea of his engine from Symington, and he made propositions to our Government, and to Napoleon during the temporary peace, for applying the principle to war ships; but the plan was rejected, as such a means of propelling ships was considered to be impracticable. In reference to Fulton's claim to be the original inventor of steam propulsion, Mr. Fairbairn said, that Fulton had most probably seen an account of Symington's experiments; but there could be no doubt that he had the precedence in bringing out steamboats in 1807, and afterwards more successful in 1810, when his steamboat was at work on the Hudson.

A Brief Description of Locking & Cook's Rotary Valve Engine, and its Advantages. By G. Locking.—In this engine a metal disk, with three apertures, slowly rotating on a flat surface, with corresponding openings connected with the boiler and the cylinders, supplies the place of the ordinary slide valves. Rotary motion is given to the valve by a vertical shaft, on which there is a pinion that is worked by a cog-wheel on the shaft of the engine. The two bearing surfaces are ground steam-tight, and an outer casing serves to confine the steam, as in the common slide valve. The advantages said to be gained by this arrangement are the diminution of friction and a more ready means of cutting off the steam and of reversing the engine. As the rotary valve has a continuous slow motion, the inconvenience and friction occasioned by the rapid reciprocating action of the slide valve is avoided. Among other advantages of this contrivance, it was stated that it costs less, is less liable to get out of order, and occupies less room. Mr. Cook, the inventor, is a working mechanic in Hull.

Mr. Fairbairn, Mr. Roberts, Mr. Hancock, and other gentlemen expressed themselves favorably of the invention, and at the conclusion of the business, the members of the Section paid a visit to Messrs. Locking & Cook's works, to inspect a steam engine constructed on this principle in action.

On a new Thermostat for regulating Temperature and Ventilation. By W. Sykes Ward.—This apparatus consists of a series of flat circular hollow cases, about one foot in diameter and one inch deep, attached together in their centres. Each case contains a small quantity of sulphuric ether, which is readily affected by change of temperature. The cases, comprising about six, are suspended one under the other, and to the lowest one is attached a weight by a cord that passes over an eccentric pulley. On an increase of temperature, the ether expands, and the weight falls down, and it is drawn up again by the pressure of the atmosphere on the external disks of the cases when the air is cooled. By connecting the weight with the ventilators of a conservatory, or other building, the temperature can be thus regulated to any required degree by a previous adjustment of the apparatus.

On a Compound Safety Valve, and *On an Improved Tubular Boiler.* By James Hopkinson.

On Railway Accidents by Collision, and their Prevention. By the Rev. Dr. Scoresby.—After adverting briefly to the numerous railway accidents caused by collision, Dr. Scoresby proposed as a means of diminishing, if not of preventing, such occurrences, the adoption of a more frequent and effectual communication by electric telegraph. His plan is

to establish telegraph stations at distances not greater than five miles apart, the connexion between them being made by separate wires, and exclusively appropriated to railway signals, and not extending continuously further than from one station to another. Whenever an obstruction occurred on the line, it should be signalled in both directions, and no train should be allowed to leave any railway station until a signal had been received from the telegraph station in advance that the line was so far clear. By the adoption of a short code of signals, these communications could be transmitted with great facility, and should any inconvenience be in the first instance experienced at junctions and cross-lines, he had no doubt that a little experience, and adaptation of the arrangements to the special circumstances, would soon remove it. The expense of such a complete system of telegraph signalling would be more than compensated to the railway companies by the avoidance of collisions, and, viewing it only in an economical point of view, the Directors would find it to their advantage to adopt such a plan. As an illustration of the pecuniary losses which railway companies sustain in consequence of accidents by collisions, Dr. Scoresby mentioned the case of a friend of his, a clergyman, who received such severe injury by a collision, that he would be for the rest of his life laid upon his back, unable to perform his clerical duties, and he and his family had to be supported at the cost of the railway company.

On Railway Collisions, with Suggestions for their Prevention. By the Rev. F. F. Statham.—The plan proposed by Mr. Statham, is to prevent collisions by adopting a more effectual means of retarding trains in motion, so that they may be brought to rest within a distance of fifty yards. He made three suggestions, the first of which was, to retard a train in motion by the expansion of wings, or of fans, to increase the resistance of the air; the second was, to employ an electro-magnetic brake, acting directly on the rails by the attraction of electro-magnets fixed to the carriages; and the third was, to cause jets of steam to issue from the front of the engine, and thus obtain a reacting resistance from the air.

In the discussion that ensued all the plans were considered. Mr. Statham's fan-retarder was shown to be altogether impracticable, since, to oppose any effectual resistance would require an expansion of acres of surface; nor were the electro-magnetic brake and the steam jets considered of much more practical utility. Dr. Scoresby's plan of telegraph signals was approved by several members, as being a more perfect carrying out of the plan which is now adopted; the chief novelty of the proposition consisting in the establishment of district wires and stations at short distances for railway purposes. Mr. Nelson, who has paid much attention to railway statistics, adduced the following curious computation in illustration of the comparatively few deaths caused by railway accidents: That if a person were born in a railway carriage, and were to be continually traveling on railways till he was killed by an accident, he would, according to the average number of passengers and deaths, live 960 years.

A Description of some of the large Valves and other Machinery which have been employed for the Discharge of Water at the Manchester Water Works. By J. F. Bateman.—Mr. Bateman described, at great length, the sources of supply and the means adopted for conveying the water

from the different collecting reservoirs to the service-reservoir in Manchester, and the peculiar valves required to cut off and regulate the water supply to the inhabitants. The magnitude of the Manchester Water Works was stated to be greater than that of the Croton Aqueduct at New York, which has been hitherto considered the largest of modern times. The three principal reservoirs will contain 500,000,000 of cubic feet of water, and there are two smaller reservoirs which hold 100,000,000; so that the total quantity stored up for the consumption of Manchester and the neighboring mills is 600,000,000 cubic feet. The furthest reservoir is 20 miles distant from Manchester, and is 420 feet above the level of the upper part of the city. The daily consumption of the inhabitants is 30,000,000 gallons, which are supplied immediately from a service reservoir 150 feet above the level of Piccadilly, at the highest part of Manchester. The valves of the main pipes which open and cut off the supply are 40 inches in diameter, and with a pressure of 150 feet on that area, it would have been impossible, without great labor of complicated machinery, to have opened and closed the valves had they been of the ordinary construction. Mr. Armstrong, of Newcastle, suggested, as a means of overcoming the difficulty, that the large valve should be divided into three, and this plan had been found to act remarkably well. A small compartment of the valve was first withdrawn, and the rush of water through it having filled the pipe, the pressure was counteracted, and the other and larger divisions of the valves could then be easily lifted. By this contrivance the mains could be opened and closed by one man. Another object to be accomplished was to arrest the flow of water in case the large pipes with such a pressure upon them should burst and flood the neighborhood. This was successfully effected by introducing into the main pipe a kind of flood gate, which was opened at a certain angle by the ordinary flow of the water, and at that inclination it held suspended, by means of a lever, a heavy weight connected with a throttle valve. When the rush of water greatly exceeds the ordinary flow, a catch that retains the lever is withdrawn, and the fall of the weight closes the throttle valve and stops the flow. This self-acting machinery has more than once prevented serious damage that would have arisen from the bursting of the pipes. Another contrivance invented by Mr. Moore, a gentleman in Mr. Bateman's office, deserves mention. The water in the reservoirs is generally beautifully clear, but during heavy rains it becomes turbid, and would be unfit for the consumption of the inhabitants without being filtered. To avoid the inconvenience and expense of filtration, Mr. Moore suggested a plan for separating the turbid water from the clear. A weir was constructed, over the edge of which, during dry weather, the water in the reservoir flows perpendicularly into a drain pipe immediately below, which conveys the clear water to the service reservoir; but in heavy rains, when the water is turbid, the extra flow shoots it over the first drain into a second, to convey it to the reservoirs that supply water power to the mills. By this simple arrangement the turbid and clear waters are separated, and it is calculated that a saving of 100,000*l.* has thus been effected. In supplying Manchester with water, a new kind of fire-plug has been adopted, consisting of a gutta percha spherical valve, which closes the apertures, and when the water is required to escape, an instrument is intro-

duced which forces down the valve. The great water pressure in the pipes forces it so high that there is no necessity for fire engines; and the effectual manner in which fires are extinguished by the torrent of water that can be thus applied has greatly diminished the cost of insurance in that city. Mr. Bateman stated, that in large establishments the diminished premiums on fire insurances produced by the increased facility of extinguishing fires are sufficient to pay the water rate. Several other arrangements of minor importance which have been introduced in the Manchester Water Works were also described by Mr. Bateman.

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*Telegraphic Progress.**

The Magnetic Telegraph Company effected their communication between this country and Ireland on Monday week, when their new cable between Donaghadee and Portpatrick was successfully laid down.

The prospectus has been issued of an association, under the title of the Mediterranean Electric Telegraph Company, formed with the object of uniting Europe with Africa, the East Indies, and Australia, by way of France, Piedmont, Corsica, Sardinia, Algeria, and Egypt. The route is said to have been carefully surveyed. The company are making arrangements for the construction of a subterranean line along the coast of Africa, from Algeria to Alexandria; and with the aid of the British Government and the East India Company, the wires may be prolonged across the Desert, the Red Sea, Arabia, and Persia, to meet the great Indian line of 3000 miles, now in course of construction by the East India Company, and which may eventually be extended to the Australian colonies. The capital is 300,000*l.* in 30,000 shares, of 10*l.* each, deposit 4*l.* per share. The Government of France is said to have guaranteed interest on 180,000*l.* and that of Sardinia on 120,000*l.* A contract has been entered into for the complete execution of the works from Spezzia to Tunis, including all preliminary expenses, and a transfer of the concessions, with exclusive privilege for fifty years, for the sum of 300,000*l.*, the amount on which interest has been guaranteed. The works are said to be already in active progress in Sardinia.

In a lecture delivered at Belfast a few weeks ago, Mr. J. B. Lindsay said that he had recently instituted a series of experiments with the view of testing an idea that he had formed some fifteen years ago—that no submarine wires are necessary for the transmission of electricity. In explanation of this principle, he said, "Suppose a wire connected with the copper end of the battery to be let down to the shore, and connected with a sheet of metal laid in the river. Suppose a wire from the zinc end taken to Broughty Ferry, and soldered to a metallic plate placed also in the river. Suppose similar plates laid in the river on the Fife side, at Newport and South Ferry, and these joined by a wire having in its course one or more telegraphs. Suppose now that a charge of electricity is sent through the wire on the Dundee side; this current may make its circuit from the copper to the zinc either by leaping four miles through the water from Broughty Ferry to Dundee, or by a leap of two miles across

* From the London Builder, No. 539.

the river to the other wire at South Ferry, and another leap of two miles from Newport to Dundee. In such a case, I have found that part of the electricity does not go across, and *part of it does;* but the part of it that does go across is sufficient to work one or ten thousand telegraphs." The possibility of this we long since noted.

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*Revolving Shutters.**

The shutter referred to by our correspondent, "J. F.," at Limerick, 45 feet long, is not so long by 6 feet as one erected by us at Water lane, Blackfriars, three years since,—passing round a corner, rolling in a space of 20 inches diameter, and opened and closed in 1½ minute: we would have no hesitation in constructing a shutter 100 or even 200 feet long on this principle. The great difficulty is to make revolving shutters with horizontal laths of great width in one piece, as the shaft or roller can have no centre support. The shutter referred to in Fleet street is 24 feet wide and 18 feet high, in one piece, and is opened or closed with ease in 30 seconds. We have recently obtained a patent for some important improvements,—first, the combining iron and wood in their construction, whereby great stiffness and lightness is obtained,—qualities, obviously of great importance; also for curving the laths of metal shutters in such a form that the joint, or hinge, is formed in the solid, greatly increasing the strength and appearance, and permitting them to be rolled in either direction, greatly facilitating their application.—*Clark & Co.*

Experimental Researches to Determine the Strength of Locomotive Boilers, and the Causes which lead to their Explosion. By William Fairbairn, C. E.†

These experiments were undertaken in consequence of the explosion of a locomotive boiler in the engine house of the North-Western Railway Company, at Manchester. It may be remembered that the immediate cause of the explosion was owing to the engine driver having screwed down the safety valve while he was talking to a companion, and leaving it in that condition. In twenty-five minutes from the time the valve was screwed down, the boiler burst with tremendous force, blowing off part of the lofty roof, and killing several men who were within the building. The boiler was a complete wreck, scarcely any portion of it remaining entire. The government inspector, who examined the wreck of the boiler shortly after the explosion, reported that the stays of the fire box had been defective, and that the boiler had not been sufficiently strong for the ordinary work. Mr. Fairbairn entertained a contrary opinion, and contended that all the parts of the boiler had been strong enough to resist six times the usual working pressure, and that the accumulated generation of steam during the twenty-five minutes that the valve had been screwed down must have amounted to a pressure of 300 lbs. on the square inch. The government inspector, however, maintained that the time was not

* From the London Builder, No. 539.

† From the London Civil Engineer and Architect's Journal, October, 1853.

sufficient to have increased the pressure to nearly that amount. In consequence of this difference of opinion, a series of experiments were instituted to determine the real causes of the explosion, and to register those facts for future guidance in guarding against such catastrophes. In the first place, Mr. Ramsbottom, the locomotive superintendent, made some experiments with the stays of the burst boiler, from which it appeared that the force required to pull the old stays out of a copper plate (similar to that of the fire box), into which they had been screwed by *the old threads only*, and not riveted, was 340 lbs. on the square inch. Mr. Fairbairn said he had carefully repeated these experiments with nearly similar results; and assuming that the ends of the screws had been riveted, and sound in other respects, it might reasonably be concluded that a strain of not less than from 450 to 500 lbs. upon the square inch would have been required to strip the screws or to tear the stays themselves asunder. It should be borne in mind, that the exploded boiler, though recently repaired, had been made many years ago, and as the cylinders were only 13 inches in diameter, it had latterly been employed only as a pilot engine to pilot the trains through the Standedge Tunnel. The stays were 5 by 5⅜ inches apart, whilst the stays of the boilers at present constructed are thicker and closer together, and form squares of 4 to 4¼ inches, by which increase of strength the resisting power would be raised to nearly 800 lbs. on the square inch.

With a view to determine by actual experiment the strength and power of resistance of the locomotive boiler, the Directors of the North-Western Railway Company placed at Mr. Fairbairn's disposal an engine, the exact counterpart of the one that exploded, both having been made at the same time by the same engineers, Messrs. Sharp and Roberts, of Manchester, and both having run the same number of miles. The engine experimented on was not, however, in the same state of repair as that of the exploded one, the fire box being considerably bulged, and the rivets as well as the stays much weakened. This boiler was subjected to hydraulic pressure, and when 207 lbs. on the square inch had been put upon it, one of the bolts of the cross bar over the fire box broke, which caused the experiment to be discontinued, as the leakage was greater than the force pump could supply. This experiment fully proved that the fire box stays—on the comparative weakness of which so much stress has been laid—are not the weakest parts of a locomotive boiler; and that there is more to be feared from the top of the furnace, which, under severe pressure, is almost invariably the first part to give way. Great care, Mr. Fairbairn said, should therefore be taken in the construction of that portion of the boiler, and the cross beam should not only be strong, but the bolts by which the crown of the fire box is suspended should also be of equal strength, in order that no discrepancy should exist, and that all parts should be proportioned to a resisting force of 500 lbs. on the square inch.

The next point to be determined by the experiments was, whether the steam of the exploded boiler could have been raised from a pressure of 60 lbs., at which it blew off from the safety valve before it was screwed down, to 300 lbs. in the course of twenty-five minutes. Mr. Ramsbottom instituted some experiments on this subject, from which it appeared, that with the furnace in the ordinary condition, steam in a locomotive

boiler was raised from a pressure of 30 lbs. on the square inch to 80 lbs. in ten minutes. Mr. Fairbairn repeated these experiments to a still higher pressure with the following results, commencing at forty-four minutes past two o'clock:—

Time, h.	m.	Pressure, lbs. per sq. in.	Mean temperature, Fahr.
2	44	11·75	243·00
2	45	14·15	247·75
2	46	16·35	251·25
2	47	19·25	255·25
2	48	22·35	259·75
2	49	25·75	264·00
2	50	28·95	268·37
2	51	32·15	273·00
2	52	35·75	277·00
2	53	39·95	282·00
2	54	44·25	286·37
2	55	48·35	291·00
2	56	52·75	295·37
2	57	57·75	300·00
2	58	63·75	304·25
2	59	68·95	308·75
3	0	75·75	313·00
3	1	80·35	317·00
3	2	87·25	322·10
3	3	93·95	326·12
3	4	101·15	331·00
3	5	108·75	335·62
3	6	111·75	The thermometer did not indicate a higher temperature than the above.

In these experiments it will be observed that the pressure was raised from 11·75 lbs. on the sq. in. to 111·75 lbs. in twenty-two minutes; and on looking at the table it will be seen the pressure was accelerated in a greater ratio than the temperature. In the first experiments, for instance, the increase of pressure was about one pound for two degrees of heat; at a temperature of 277° it was as three to four; at 317°, the pressure increased about a pound for each degree; and at the end of the experiments, the proportions as four of heat to five of pressure. Mr. Fairbairn stated that he considered it more than probable, that had the instruments been calculated for higher temperatures and higher pressures, the point of explosion from 60 lbs. to 350 lbs. or 400 lbs. on the square inch would have been reached in twenty-eight minutes.

Those parts of a locomotive boiler comprised in the flat surfaces of the fire box were afterwards put to the test of experiment. Two thin boxes with flat surfaces, each 22 inches square and 3 inches deep, were constructed; one of them corresponding in the thickness of its plates ($\frac{7}{16}$-inch), distance of the stays, and in other particulars, with the sides of the fire box of the exploded boiler; and the other was formed of plates of the same thickness, but with the stays only four inches apart instead of five. The first box, therefore, containing sixteen squares of 25 inches area, represented the exploded boiler; the other, with twenty-five stays of 16 inches area, represented the new construction of boilers. When hydraulic pressure was applied to the first box, not the least swelling of the sides was perceptible till a pressure of 455 lbs. on the sq. in. had been put upon it, and then the swelling amounted to only ·03 of an inch. At a pressure

of 815 lbs. the box burst, by drawing the head of one of the stays through the copper, which, from its ductility, offered less resistance to pressure in that part where the stay was inserted. The swelling of the sides the minute before bursting was ·08 of an inch. In the next series of experiments with the box, in which the stays were placed closer together, the following results were obtained, showing the relative pressures and swellings of the sides up to 1595 lbs. on the square inch. At a pressure of 1625 lbs. the box burst, by one of the stays drawing through the plate, after sustaining the pressure upwards of a minute and a half:—

Pressure in lbs. per. sq. in.	Swelling in the sides in ins.	Pressure in lbs. per sq. in.	Swelling in the sides in ins.
485	·04	1445	·12
575	·06	1475	·13
635	·07	1495	·14
755	·08	1535	·16
965	·09	1565	·22
1355	·10	1595	·34
1385	·11		

The foregoing experiments Mr. Fairbairn considered to be conclusive as to the superior strength of the flat surfaces of a locomotive fire box, as compared with the top or even with the cylindrical part of the boiler. The enormous pressure sustained by the flat surfaces of a fire box when stayed in the manner now adopted, as exemplified in the second series of experiments, is greater than can possibly be attained in any other part of the boiler, however good the construction; in fact, there is no limit to the pressure that may be sustained if the stays be increased in thickness and in number.

In the discussion which ensued on the reading of this important paper, Mr. Samuelson observed, that as many flat marine boilers are now being constructed, it was desirable that the results of the foregoing experiments should be extensively known, as they would tend to remove the prejudice which had been so long entertained against the use of flat boilers.

In reply to a question, whether the heat requisite to get up a pressure of steam equal to the hydraulic pressure applied might not weaken the iron, Mr. Fairbairn stated, that the effect of heat on the strength of wrought iron was a subject he was about to investigate, but at present he could not give a definite answer. With respect to cast iron, he had determined that the strength increased up to a temperature of 300° Fahr., and at higher temperatures it became weakened.

Mr. Hopkinson said, that he understood experiments had been made with wrought iron in America, from which it appeared that the strength continued to increase to as high a temperature as 600°.

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*Experiments on the Effect of Re-Melting on the Strength of Iron.**

Mr. Fairbairn presented a report of experiments undertaken at the request of the Association, "On the Mechanical Properties of Metals as derived from repeated Meltings, exhibiting the maximum point of Strength and the Causes of Deterioration." In making the experiments, one ton of Eglinton hot-blast iron was operated on. The proportions of flux and coke at each re-melting were accurately measured, so as to be alike in each. The iron was run into bars 1 inch square, and the trials were made

* From the London Civil Engineer and Architect's Journal, October, 1853.

on lengths of about 4 feet, supported at each end, and the weight applied in the centre gradually, until the bar broke. One bar was reserved at each trial, and the rest of the iron was re-melted This succession of remeltings and trials was repeated seventeen times, when the quantity of iron was so much reduced, that it was not considered desirable to continue the experiments. The results obtained prove that cast iron increases in strength up to the twelfth melting, and that it then rapidly deteriorates. The commencing breaking weight was 403 lbs., and this went on increasing until at the twelfth melting the breaking weight was 725 lbs. At the thirteenth it was 671 lbs.; at the fifteenth, 391 lbs.; at the sixteenth, 363 lbs.; and at the seventeenth melting the bar broke with 330 lbs. After the fourteenth melting, the molecules of the metal, when fractured, appeared to have undergone a decided change. There was a bright band, like silver, on the edge of the bar, whilst the middle retained the ordinary crystalline fracture; and in the succeeding meltings the metal was bright all over, resembling the fracture of cast steel. Mr. Fairbairn exhibited specimens of the iron broken at each successive melting, and he said it was his intention to have them analyzed, to ascertain the chemical change that had been effected by the repeated processes.

---

*On the Combined Steam and Ether Engine.**

Mr. G. Rennie made a communication "On the Combined Steam and Ether Engine," a French invention applied to propel a ship from Marseilles to Algiers, which he had lately examined. Mr. Rennie had been requested to investigate the working power of this engine, and, accompanied by his son, he made a voyage in the vessel from Marseilles to Algiers and back. The engine was originally intended to be worked by steam, and the boiler is adapted to an engine of 30 horse power. The principle of the construction as it is now worked is this: The heat given out by the steam in condensing is applied to boil ether; the vapor thus generated is admitted into a distinct cylinder, and the work it does is so much gained from the waste heat of the steam. The condenser is sursounded by tubes containing the ether, which thus aids in condensing the steam; and as ether boils at a temperature of 100° Fahr., there is a tolerably efficient condensation of steam produced by the temperature at which the ether boils. The ether, after having done its work in its separate cylinder, is condensed in a refrigerator surrounded by cold water, and it is then again in a state to act as a condenser of the steam. The loss of either vapor by leakage during this repeated vaporization and condensation, amounts in value to one franc per hour. Special arrangements are made for dissipating the vapor that escapes, so as to prevent ignition, and with that provision Mr. Rennie considers there is no danger. In the return voyage, Mr. Rennie placed the coal under lock and key, and superintended the delivery of it, so that no deception might be practised, and he estimates the saving of fuel from this combination of ether with steam at nearly 70 per ct. It had been estimated by a French commission at 74 per cent. The French government have paid the inventor, M. Dutromblet, a large sum for the invention, and are about to put it in operation in a ship of 1500 tons burthen, with engines of 150

* From the London Civil Engineer and Architect's Journal, October, 1853.

horse power, which will have the advantage of the experience gained during the working of the present engine.

Mr. Taylor, Jr., the son of the engineer who constructed the engine of the Marseilles boat, said that there were many defects in the present arrangement, which would be remedied in the engines about to be made. The condensers are at present very imperfect, and do not expose a sufficient surface.

Mr. Sykes Ward said, that good ether does not corrode metals; therefore, there could be no objection to the employment of it on that account. The attempts that had previously been made to apply spirituous vapor as a motive power necessarily failed; because though alcohol and ether boil at a much lower temperature than water, their vapors are much heavier, and carry off as much heat at a given pressure, when applied, as steam.

Mr. Fairbairn stated, that in the best Lancashire steam engines, when working expansively, 2¾ lbs. of coal per horse power is the quantity consumed, which was nearly equal to the quantity consumed during the voyage from Algiers to Marseilles—whilst some of the steamboats on the Humber burn 10 lbs. of coal per horse power; therefore, compared with that wasteful expenditure of fuel, the steam and ether engine presented great advantages.

Other members spoke encouragingly of the combined power, though the condensation of the steam it was considered must be imperfect, as the vacuum is not good at a temperature higher than 90°.

---

*French System of Iron Floors.**

These floors are composed of joists, slightly arched in the proportion of 0·005 metre in the metre; they are placed at the distance of 1·00 metre from centre to centre, and are united by *entretoises*, or flat bars of iron, at the same distance apart. These entretoises rest on the lower projecting edges of the joists, and are secured in that position by passing into, and being fastened to, a band round the joists.

On the entretoises are tied (by means of wire) square iron rods, the same length as the joists.

Certain joists have ends fitted to act specially as ties, as have also the entretoises; thus the whole being firmly built into the walls, the sides of the houses are effectually united. The iron work is then painted, and afterwards filled with pottery bedded in plaster, or with plaster alone, by which process a ceiling is formed to the apartment below; this portion of the work is done as soon as the walls are of sufficient height to receive it.

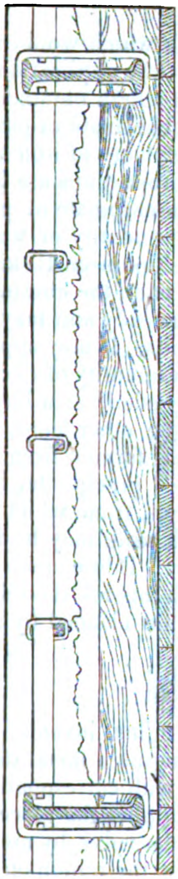
Where a wooden floor is required, it is nailed to small joists notched in between the iron work.

The joists are of rolled iron, regulated in their size and depth by their span; the other portions are made in a manner to insure their going together without the aid of forge or file at the place of construction.

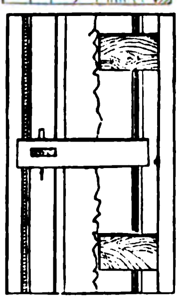
The whole, complete, forms a floor at once light and fire proof, occupying about 15 per cent. less space, and adding (in Paris) little to the ordinary cost of wooden construction.

The accompanying drawing is for a span of from 5·00 to 6·00 metres, upon the system of Mr. Thuasne. H. H. B.

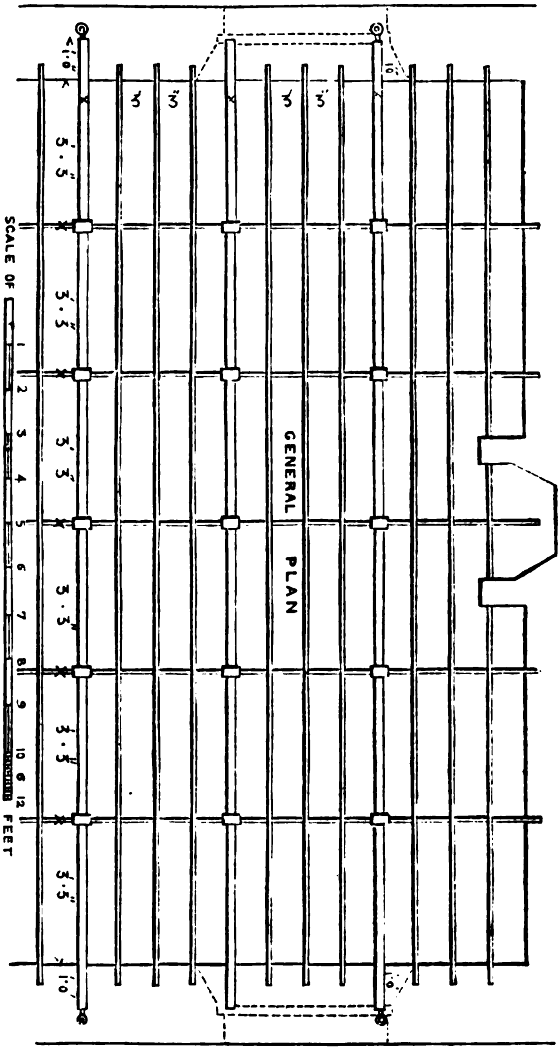
* From the London Builder, No. 539.

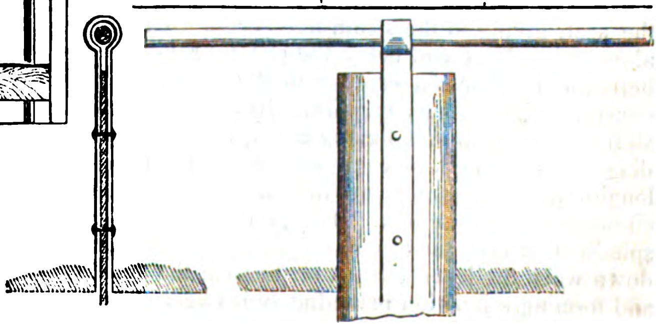


Section across Joist.



Side of Joist.





End of Joist where used as a tie.

*Ink for Steel Pens.**

Professor Runge has long sought to obtain an ink which would not yield sediment, which should adhere to paper, resist the application of acids, and have no action on steel pens. He has at length obtained a liquid of this kind, containing only Campeachy wood, chromate of potassa, and water. As it contains neither vinegar, gum, sulphates of iron and copper, nor galls, its cost is very moderate. The proportions are 500 litres decoction of Campeachy wood to 500 grammes chromate of potassa. The Campeachy wood is boiled in a sufficient quantity of water to form 80 litres ($4\frac{1}{2}$ litres = 1 English gallon) of decoction from 10 kilogrammes of wood (about 20 lbs). After the liquid is cool, the chromate is added and the whole well stirred. The ink is then ready and may be used at once. Any addition of gum would be injurious. It may appear strange that so little chrome should convert so large a quantity of decoction into ink. But the proportion must not be exceeded, as a larger amount would destroy the coloring matter. If, on the other hand, the proportions here given are observed, a blackish-blue is formed from the yellow pigment of the wood. This is not a suspended precipitate, like the gallate of iron in common ink, but a true solution, from which no sediment can be deposited. A paper written with this ink may be immersed in water for twenty-four hours without injury. Dilute acids do not destroy it or change its tint. The pens used with this ink should be perfectly free from grease, and may for this purpose be cleaned by immersing them in ley of wood ashes.

Description of a Rotary Steam Valve.†

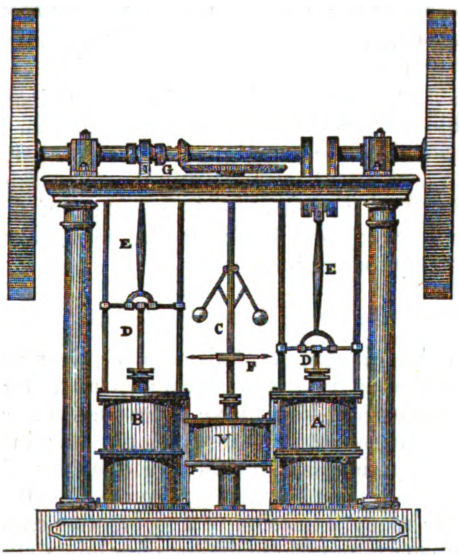
Mr. Locking gave a description of a rotary valve engine, invented by Mr. Cook, a working mechanic, of Hull. In this engine a metal disk, with three apertures, slowly rotating on a flat surface, with corresponding openings connected with the boiler and cylinders, supplies the place of the ordinary slide valves. Rotary motion is given to the valve by means of bevel gear fixed to the crank shaft and valve spindle, the pinion on the crank shaft being to the bevel wheel on the spindle in the proportion of three to one, so the valve makes only one revolution in the time the crank takes to revolve thrice. The valve has three perforated apertures or steam ways, beneath which, in the face of the seat upon which the valve works, are four steam ways, two each for the right and left hand cylinders. The valve is so constructed that the steam ways through it pass over those in the seat, giving to the steam free access from the chest to the cylinders alternately, above and below the piston. Like the slide valve, it is chambered, and the steam escapes to the exhaust pipe, the air, or the condenser, as in ordinary engines. Reversing is effected by a lever and sliding box, each end having a slot, one of which is straight, the other diagonal, the length of each being equal from point to point on the box longitudinally; the transverse distance of the diagonal being one-sixth the circumference of the box. Through these are pins made fast to the valve spindle, that keep the box in its position, only allowing it to move up and down when the lever is lifted or pressed; the spindle being in two parts, and forming a junction immediately between these pins, in the centre of

* From the London Artizan, October, 1853.

† From the London Civil Engineer and Architect's Journal, October, 1853.

the box. By moving the lever up or down, the spindle with the diagonal alters its relative position to the other with the straight slot; thus the valve is carried round one-sixth of its revolution, thereby changing the position of the steam ways, and reversing the engine. Both cylinders will receive and cut off the steam at the same point, and thus prevent one valve rod wearing more than the other, on one eccentric being before the other. Another advantage of the valve is stated to be greater facility in working the steam expansively, and cutting it off at any point of the stroke. The cost of the engines will, it was said, be much less than those now in use. Consisting, too, as it does, of little more than cylinders and cranks, it will be much less liable to get out of order. Another advantage is, the great ease with which the engine may be reversed when the steam is full on; the engineer, by the use of a single lever, can regulate to a nicety the quantity required, and ease, stop, or reverse at pleasure.

Fig. 1.—Side Elevation.



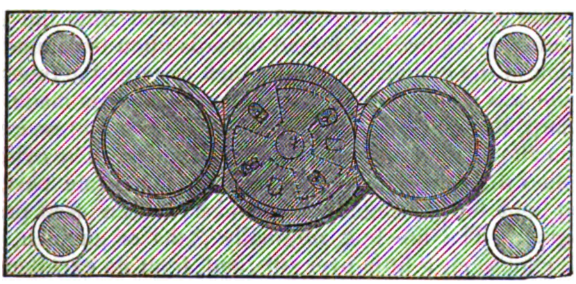


Fig. 2.—Plan (*Enlarged Scale.*)

The annexed engravings and references explain the different parts of the valve and its action:—v, valve; c, valve rod; a, b, cylinders; d, d, piston rods; e, e, connecting rods; f, reversing wheel; g, bevel wheel

and pinion for working valve. 1, aperture for the admission of steam to valve; 2, the valve upon its face in steam chest; 3, 4, steam ways above and below piston in cylinder A; 5, 6, steam ways above and below piston in cylinder B; 7, exhausting pipe into condenser, or (if high pressure) into the air; *a*, *b*, *c*, (fig. 4,) steam ways or apertures through valve to admit the steam to cylinders. The same are shown by the dotted lines on fig. 2, in which one of the apertures in valve coincides with No. 5 steam way to cylinder B; the direction of the rotation of valve is indicated by the arrow. *d*, *d*, *d*, *d*, chambers for exhausting steam through valve to exhausting pipe No. 7. *e*, *e*, *e*, shows the lap upon the valve.

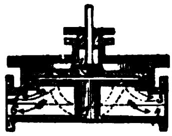


Fig. 3.—Section of Valve.

Fig. 4.—Working Face of Valve.

Mr. Oldham said, he considered it a decided improvement on any valve he had had an opportunity of examining.

Mr. Fairbairn said, it contained many important elements of improvement, but he did not see how it would save time, or how it would be more economical than the ordinary engine. Altogether, however, it appeared to him to be a very happy effort in the right direction.

At the conclusion of the business, the members of the Section paid a visit to Messrs. Locking and Cook's works, to inspect a steam engine constructed on this principle in action.

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*On Steam Boiler Explosions.**

At the British Association, Mr. Fairbairn, C. E., read a paper detailing some very interesting results of researches made for the purpose of determining the strength of locomotive boilers, and the causes which led to explosions. These researches were entered into in consequence of some difference of opinion having arisen between Mr. Fairbairn and Mr. Wynn, connected with the railway department of the Board of Trade, as to the cause of the recent explosion of a locomotive engine at Longsight. Mr. Fairbairn, upon examining the boiler a few hours after the explosion, found one side of the fire box completely severed from the body of the boiler, the interior copper box forced inwards upon the frame, and, with the exception of the cylindrical shell which covered the tubes, the whole of the engine was a complete wreck. The engine was made in 1840 by Messrs. Sharp, Roberts & Co., had been worked at a pressure of 60 lbs., and had run altogether a distance of 104,723 miles. The cylinders being only 13 inches diameter, the engine had, for some time past, been considered too light for passenger trains, and had been used principally as a pilot engine. The fire box, originally $\frac{7}{16}$ths of an inch, was, at the time of the explosion, a little over $\frac{3}{8}$ths, and, from its excellent condition, might have been supposed but to have recently been put into use; it was perfectly free from flaw, and might, but for the accident, have traveled 100,000 more miles. The engine had been in the repairing shop about three months previous to the accident, and the whole of the stays had

* From the London Civil Engineer and Architect's Journal, October, 1853.

been tested by the hammer, in the usual mode. The only point which could admit of doubt as to the safety of the boiler, was with respect to the hold which the stays might have in the fire box. Experiments, however, had proved that the force required to pull some of the stays out of a copper plate similar to the fire box, into which they had been screwed, could not have been less than a pressure of about 300 lbs. per square inch. It required a dead weight of 8204 lbs. to pull out the "stay," and, as each "stay" had to support a surface of 27 square inches, it would require a pressure of 303·85 lbs. per square inch to strip the boiler. Supposing the stays to be riveted and sound in other respects, it would require a strain of not less than from 450 lbs. to 500 lbs. upon the square inch, in order to strip the screws or tear the stays asunder. In the case of locomotives of more recent construction, where the stays were thicker, and formed into squares of from 4 to 4½ inches, the resisting force would be increased from 700 to 800 lbs. on the square inch, or at least seven times the working pressure. Considerable stress has been laid upon the weakness of the stay which united the flat surface of the boiler to the sides of the fire box. The experiments made, however, clearly indicated that the fire box stays were not the weakest parts of a locomotive boiler, and that we had more to fear from the top of the furnace, which, under severe pressure, was almost invariably the first to give way. Great care, therefore, ought to be observed in the construction of this part. The cross beams should not only be strong, but the bolts by which the crown of the fire box was suspended should also be of equal strength. It was in order to determine, if possible, by actual experiment, the laws on which these powers were founded that he had undertaken this series of experiments. The directors of the London and North Western Railway Company had placed in Mr. Fairbairn's hands an engine of the same age, constructed by the same makers, and in every respect a fac-simile of that which had exploded. The engine was subjected to hydraulic pressure in the following manner. The boiler was furnished with a valve of one inch area, and the lever gave as the weight upon the valve 35 lbs., the scale being suspended indicated 50 lbs. The abstract of the results was the following:—

No. of lbs. on scale.	Weights upon valve.	Remarks.
Lever	35	
Scale	50	
1	65	
2	80	
3	85	
4	110	With this pressure a leakage was observed at some of the joints.
5	125·5	
6	140	Leakage increased.
7	155	
8	170	Leakage still increasing.
9	185	
10	200·5	
10½	207·5	

With this last pressure one of the bolts of the cross bar over the fire box broke, which caused the experiment to be discontinued, as the leakage was greater than the force pump could supply.

It had been stated that the steam could not have been raised from 60

lbs. pressure per square inch for that stated by Mr. Fairbairn, in so small a space of time as 25 minutes. Experiments, however, tested by Bourdon's steam gauge, had shown that the pressure could be raised from 30 lbs. to 80 lbs. per square inch in 11 minutes. It was considered necessary, however, to carry these experiments to a still higher pressure than 80 lbs., and to ascertain not only the exact time, but the ratio of increase, and the current of temperature of the steam in the boiler. In order to carry out these experiments, two delicately constructed thermometers were prepared by Mr. Dalgette, and Bourdon's pressure gauge having been adjusted with a column of mercury, the following results were obtained, on the 7th May, on a locomotive engine, with the safety valve screwed down and the fires lighted under the boiler:—

Time.		Pressure.	Mean temperature.	
2h.	44m.	11·75	243°	0′
2	45	14·15	246	75
2	46	16·35	251	0
2	48	22·35	259	75
2	50	28·95	268	37
2	52	35·75	277	0
2	54	44·25	286	37
2	56	52·75	295	37
2	58	63·75	304	25
3	0	74·75	313	0
3	2	87·25	322	0
3	4	101·15	331	0
3	5	108·75	335	62
3	6	111·75		

This experiment was lost, the thermometer not indicating a higher pressure. The results deducible from these experiments were at the rate of increase in the accumulating force of the steam, and the equivalents in temperature corresponding thereto. In the first experiment the pressure was raised from 30 to 80 lbs. in 11 minutes; but in the latter, from 11·75 to 111·75, or not less than 100 lbs. in 22 minutes. Other experiments were made for the purpose of testing the strength of stays in the fire box. Two thin boxes, each 22 inches square and 3 inches deep, were constructed, one of them corresponding in every respect to the sides of a fire box of the exploded boiler, the other of the same thickness of plates, but the stays arranged in squares 5 inches asunder. Tested by hydraulic pressure, it was found, on the 19th experiment, that, with a pressure of 785 lbs. per square inch, the side swelled ·08 inch, and with the 20th, with a pressure of 815 lbs., the box burst, by drawing the head of one of the stays through the copper, which, from its ductility, offered less resistance to the pressure on that part where the stay was inserted. These experiments were conclusive as to the superior strength of the flat surfaces of a locomotive fire box, as compared with the top or cylindrical part of the boiler; but other experiments, in which the stays were closer together, showed that a resisting force was obtained much greater than any which it could possibly have to sustain. For instance, in the case of boilers where the stays were arranged in areas of 16, instead of 25 square inches, he had found, on the 47th experiment, that a pressure of not less than 1625 lbs. on the square inch, producing a swelling in the sides of 0·34 inch, was required, in order to draw the stay through the plate, after sustaining the enormous strain for one minute and a half.

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Contents for November, 1853.

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OF THE

State of Pennsylvania,

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DEVOTED TO

Mechanical and Physical Science,

CIVIL ENGINEERING, THE ARTS AND MANUFACTURES,

AND THE RECORDING OF

American and other Patented Inventions.

EDITED BY

JOHN F. FRAZER.

Assisted by the Committee on Publications of the Franklin Institute.

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1853.

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They therefore propose to forward, *free of postage*, two copies for one year to any present subscriber who shall send the name of one new subscriber, and remit the sum of Eight Dollars. And, in like manner, to forward three copies to any subscriber who shall send the names of two new subscribers and Ten Dollars. A club of new subscribers remitting to the Actuary, Eight Dollars, will be furnished with two copies for one year, and for Ten Dollars three copies for one year.

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OF THE STATE OF PENNSYLVANIA

FOR THE

PROMOTION OF THE MECHANIC ARTS.

DECEMBER, 1853.

CIVIL ENGINEERING.

On Hollow Railway Axles. By J. E. M'CONNELL, of Wolverton.*

[Paper read at the Institution of Mechanical Engineers.]

The subject of railway axles was brought before this Institution on a former occasion by the writer, when he gave the result of various experiments, showing the form and dimensions most economical of material, with a proportionate and proper strength of the several parts, and also the changes in the structure of the iron which appeared to have taken place from various causes during the course of working. Since that period the writer's attention has been constantly directed to the subject, and the opinion he then expressed respecting the fractures of axles arising from changes from the fibrous structure of the iron, to a brittle, short-grained, or crystalline condition, has been confirmed by repeated instances which have come under his knowledge.

With the view of improving the strength and durability of railway axles—the two most important points for insuring the safety and security of railway traveling—the writer, after repeated experiments, and obtaining all the experience and information he could collect on the subject, arrived at the conclusion that the hollow or tubular axle combined in itself, if properly manufactured, all the properties necessary to secure the best form for lightness, strength, uniformity of structure in the material, elasticity to neutralize the injurious effects of blows and concussions, and consequent durability, from having a greater freedom from deteriorating effects.

The selection of the tubular form of axle originated from the knowledge, that with a considerably less weight of material in the form of the tube,

*From the Civil Engineer and Architect's Journal, October, 1853.

a much greater strength can be obtained to resist torsion, deflexion by pressure or weight, or concussion from blows. The resistance of a solid system to deflexion and torsion, increasing in proportion to the fourth power of the diameter (or the square of the square), but the weight increasing only as the square of the diameter, two solid cylinders, having the respective diameters of 4 and 5 inches, or 1 to $1\frac{1}{4}$, will have a proportionate weight of 16 to 25, or 1 to $1\frac{1}{2}$, but a resistance of 256 to 625, or 1 to $2\frac{1}{2}$. Then if a hollow of two-thirds the diameter be made in the larger axle, its weight will be diminished $\frac{1}{2}$ ($\frac{2}{3} \times \frac{2}{3} = \frac{4}{9}$ or $\frac{1}{2}$ nearly), and its resistance only $\frac{1}{5}$th ($\frac{2}{3} \times \frac{2}{3} \times \frac{2}{3} \times \frac{2}{3} = \frac{16}{81}$, or $\frac{1}{5}$th nearly), and the comparison with the smaller solid axle will then be 1 to $1\frac{1}{4}$ in diameter, 1 to $\frac{7}{8}$ in weight, and 1 to 2 in resistance, being double the resistance, with $\frac{1}{8}$th less weight.

The use of hollow axles was tried some years ago, but was not continued, the main objection being, that there appeared a great difficulty of insuring, by the particular mode of manufacture adopted at that time, a sufficient uniformity of thickness of the sides of the tube throughout, and also of the soundness of material. The mode adopted consisted of rolling two or three bars of a semicircular cross section, which were welded together with butt-joints, but with no internal pressure, and with solid ends where the bearings came. These axles, having no mandril or internal pressure during the process of welding, were found to be of a very uncertain strength throughout the axle, and the weakest point might be close to that part where the greatest force or strain would be exerted.

To overcome these objections, a mode of manufacturing railway axles has been introduced by the writer, which, it is believed, effectually accomplishes the object in view, securing the utmost strength with the least possible amount of material, uniformity of structure of the iron, perfect equality of thickness of material, and soundness of manufacture.

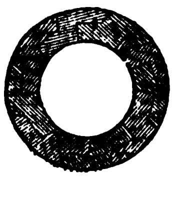

Fig. 1.

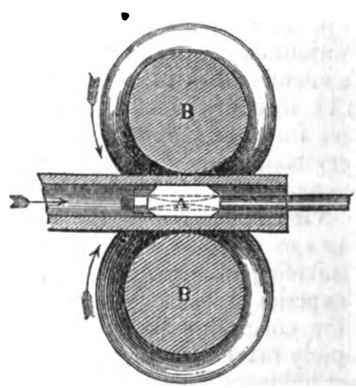

Fig. 2.

The plan adopted is as follows:—A number of segmental bars of the best quality of iron are rolled to a section, so as to form, when put together ready for welding, a complete cylinder, fig. 1, about $1\frac{1}{2}$ times the diameter of the axle when finished, the bars fitting correctly together, so as to

have no interstices, and overlapping in such a manner as to insure a perfect and sound weld when completed, as shown in fig. 1.

This cylinder of loose segmental bars is temporarily held together by a screw-clip, and each end being put into the furnace until a welding heat is produced, the bars are then partially welded together, and the clip removed. The whole cylinder is then placed in the furnace, and brought to a proper welding heat; it is then passed through a series of rollers, B, B, fig. 2, which have each a mandril of an egg-form, A, in the centre of the circular openings, which are attached and supported on the end of a fixed bar, the bar being firmly secured at the opposite end, to resist the end pressure or strain during the process of rolling. The mandrils are made of cast iron, chilled, fitting on like a socket on the end of the bar to a shoulder, and they are secured by a screw-nut, so that they are easily removed when required.

The motion of the rolls is so arranged, by a reversing-clutch on the shaft, that as soon as the axle-cylinder has been drawn clear through, the motion is reversed, and the axle, which has been drawn on to the mandril-rod, is again drawn back through the same opening in the rolls; it is immediately passed through the next smaller groove of the roll, with a decreased size of mandril, and again reversed back through the same groove in a similar manner, and so on through a series of grooves in quick succession, each decreasing in size, and consequently increasing the compression and strength of the iron of which the axle is formed, an d by the last groove it is passed through it is reduced to the proper diameter. At each time it is changed from one groove to another, the axle-cylinder is turned by the workman a quarter round, so as to equalize the pressure on every part of its surface, to insure uniformity of the compression of the iron, and thoroughly complete a sound welding throughout every part of the axle.

The specimens before the meeting showed the soundness and perfection of the manufacture, as a proof of which, in every test applied, either by blows on the outer surface or by an immense splitting pressure, by driving a mandril in the interior, there has never been found in any one instance a failure of the weld, although the test has been applied to pieces cut off the extreme end, where it might be supposed the welding of the cylinder of the axle, from various causes, would not have so good a chance of being perfect.

The axle at this stage, after being welded and drawn down in the rolls to the proper size, is taken at once to a hammer, where it is planished between semicircular swages over its entire surface. A small jet of water plays upon it during this process, which enables the workman to detect at once, by the inequality of color, any unsoundness in the welding. From the hammer it is taken to the circular saws, where it is cut accurately to the length required, and ready to have the bearings formed upon it.

On coming from the hammer, the axle is found to be perfectly clean both inside and outside, the scale being entirely removed. The ends are then re-heated, and gradually drawn down by a hammer to the proper dimensions and form of the journals, a mandril being inserted in the end of the tube during the process of hammering.

The formation of the journals can also be produced by a rolling machine, constructed of tables the entire length of the axle, rolling transversely, each table being a duplicate of the other, and matrices of the axle when finished. Or in another way, by two sets of rollers, each set consisting of three rollers running vertically, being of the same diameter, and driven at the same velocity, formed exactly to the shape of the bearing, and set the proper distance apart from shoulder to shoulder of the journals.

The manufacture of these axles has been intrusted to the Patent Shaft Company, and a great amount of credit is due to Mr. Walker, the managing partner of that firm, for the very excellent system he has adopted and carried out in the process of manufacture.

As an illustration of the saving in dead weight, take, for instance, a railway employing 15,000 wagons and carriages, and assume each of these vehicles to run on an average 10,000 miles per annum. The weight of two axles of the solid description finished, say 5 cwt., and if replaced with hollow axles of equal strength, the weight per vehicle may be reduced $1\frac{1}{2}$ cwt.; this taken over one mile of the above stock per annum will be 11,250,000 tons, and assuming the cost of traction for locomotive power at $\frac{1}{4}d.$ per ton per mile, the saving will amount to 11,700*l.* per annum, without taking into account the other advantages, and also the saving to the permanent way, &c.

In the samples of axles submitted to the meeting, two different kinds of bearings were shown, the parallel bearing with the rounded shoulder, and also the double conical bearing, such as is used on the Great Northern, Great Western, Bristol and Exeter, South Wales, and South Devon Railways. In either description of bearing, the hollow axle is good, although it is believed that the conical bearing for *either* the solid or hollow axle has less tendency to injure the texture of the iron during the formation of the journal than the parallel shouldered axle, and it appears a matter well deserving the consideration of the Institution, to ascertain what, under all conditions, is the best form of axle bearing.

Experiments, conducted by Mr. Marshall, the Secretary of the Institution, have been tried for the purpose of ascertaining the comparative strength of the hollow and solid axles to resist a transverse strain. Each axle was supported on massive cast iron blocks, fixed at a distance of 4 feet 11 in. apart, to represent the support given by the rails to the axle. A cast iron block weighing 18 cwt. was then let fall on the centre of the axle from a height of 12 feet, and the extent of bending was measured. The axle was then turned half round, and another similar blow given on the opposite side, bending it in the opposite direction. This proceeding was repeated until the axle was broken. The general results of these experiments are as follows:—

An *Old Solid Axle*, $3\frac{3}{4}$ inches diameter in centre, $4\frac{1}{4}$ inches at ends, which had been at work three years, was bent $8\frac{3}{4}$ inches by the first blow; it was nearly straightened by the second blow in the opposite direction, then bent 10 inches by the third blow, and with the sixth blow it was broken in the centre square across.

A *New Solid Axle*, of the same dimensions, was bent $9\frac{3}{4}$ inches by the first blow, then nearly straightened by the second blow, and bent $9\frac{1}{2}$ inches

by the third blow, and by the fourth blow 2½ inches, and by the fifth blow it was broken ¾-inch from the centre. The appearance of the fracture was crystalline over three-fourths of the section, the remaining part tough fibre.

A *New Hollow Axle*, 4⅝ inches diameter throughout, was bent 5 inches by the first blow, nearly straightened by the second blow, and bent again 5 inches by the third blow. The ninth blow bent it 4½ inches, and the tenth blow 1⅜ inch. Up to the fifteenth blow it was bent alternately, the bends varying from 2 to 3½ inches. There was no appearance of failure or cracking, but a slight rising of the surface at the fifteenth blow. The blows were continued to the twenty-seventh, the bends varying from 2 to 3⅝ inches, and at this blow a fracture took place across the middle of the axle 1½ inch long. The twenty-eighth blow bent it ⅜-inch, and closed the fracture on the opposite side made by the preceding blow. By the twenty-ninth blow it was fractured two-thirds through, and bent 9½ inches, the appearance of the fracture being very fibrous.

A second series of experiments was made, to ascertain the comparative strength of the journals of the hollow and solid axles to resist breaking.

Each axle was supported on an anvil, with the inner shoulder of the journal projecting 1½ inch beyond the edge of the anvil, to represent the support of the axle in the nave of the wheel; 100 blows with two 24 lb. sledge-hammers were then struck upon the upper side of the outer end of the journal, the men being changed after striking each twelve or thirteen blows alternately. The amount of bending of the journal was then measured, and the axle turned half over, and another 100 blows similarly given on the opposite side of the journal; the same proceeding being then further repeated. The general results of these experiments are as follows:

An *Old Solid Axle*, with 3 by 5 inch journals, that had been at work three years, had one journal broken off with 205 blows, and the other with 53 blows; both fractures were square across the journal at the shoulder.

A *New Solid Axle*, with 3 by 6 inch journals, had the journal broken off with 570 blows, the fracture being irregular in form, and fibrous.

A *New Hollow Axle*, with 3 by 5 inch journals, had 400 blows on the journal, which bent down the end ⅝-inch, and produced a longitudinal split on the under side 3¾ inches long, but no transverse fracture.

A *New Hollow Axle*, same size journals, received 800 blows on the end of the journal, which bent it down ⅛-inch, and split the journal longitudinally on both sides, but caused only a slight transverse crack near the shoulder, ¾-inch long.

The experiments on transverse strength by a heavy weight falling on the centre of the axle, and giving the blow on opposite sides alternately, show that the hollow axle is nearly double the strength in that respect of the corresponding solid axle, the amount of bending being only 5 inches instead of 9¾ inches; and the number of blows required to break the hollow axle being 29, whilst the solid axle broke at the fifth blow, shows the hollow axle to be greatly stronger in resistance to fracture.

The hollow axle became ⅛-inch oval in the centre after receiving the seventh blow, and it was only ¼-inch oval after receiving the twenty-

eighth blow just before fracture; being bulged outwards $\frac{1}{18}$-inch at each side, and $\frac{1}{18}$-inch inwards at top and bottom from the original circular section.

The experiments on strength of journals show, that instead of the journals breaking off square and short at the shoulder, as in the solid axles, the hollow-axle journals stand a considerably greater number of blows, and then only split up longitudinally, instead of breaking off transversely, being a very important advantage in point of safety in working.

In the course of the discussion which followed the reading of the paper, it was remarked, that in the fracture of the hollow axle all the iron appeared fibrous, but the fracture of the solid axles was mostly crystalline; that the saving in weight of the hollow axles was about two-fifths theoretically to obtain the same strength, but it had been taken at one-third of the solid axles, to be on the safe side. The hollow axles were being extensively applied on the North-Western, Midland, and Great Northern Railways, and more than 500 had already been made; some had been at work for nine months with entire satisfaction.

Mr. M'Connell observed, that whatever was the nature of the strain, and the change produced by concussion, the effect of the continued blows and concussion to which a railway axle was subjected, must be greatly diminished when the axle had a large hollow through the centre, instead of being entirely solid, as the effect of a blow on one side would be mostly lost in the vacant space of the centre, instead of being all communicated through the mass of the axle. He showed specimens of a hollow and a solid axle, which had been run hot for two hours without oil in a lathe, at a speed corresponding to about twenty miles an hour traveling; the solid journal broke off with 179 blows quite short and crystalline, but the hollow journal would not break transversely and split longitudinally in several places with 400 blows, and did not appear injured.

Mr. Adams said, he thought the conical journals were preferable to the ordinary cylindrical ones, and they were particularly adapted to the manufacture of the hollow axles, by avoiding the sudden shoulder. He had found the conical journals less liable to heat than the others when well fitted; in the cylindrical journals, as square shoulders were found preferable in practice to shoulders much rounded, it was important to maintain a uniform strength of metal at the shoulder.

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*English and American Railways.**

We alluded last week to the average cost of a mile of railway in New York State. This is given at 36,701 dollars, or £7500 per mile of single line, including sidings, locomotive and working stock, &c., &c. This average is, however, higher than that of other American states, and is caused by the high charges for the Rochester and Syracuse, 104 miles long; the Hudson River, 144 miles long; the Albany and Schenectady, 17 miles long; the Troy and Greenbush, 6 miles long. These cost about 50,000 dollars, or £10,400 per mile. The New York and Erie, however, 461½ miles, cost nearly as much, namely, 50,344 dollars, or £10,488 per mile.

*From Herapath's Journal, No. 734.

The cost of several of the lines is much below these rates. The dollar we have reduced, as before, at the rate of 50 pence.

	Length miles.	Dollars.	£.
Northern,	118	35,110	7310
Troy and Bennington,	5	33,856	7050
Buffalo and Rochester,	76	32,295	6740
Saratoga and Washington,	53	31,439	6540
Schenectady and Troy,	20½	31,160	6480
Troy and Boston,	26	30,391	6330
Rensselaer and Saratoga,	25	29,226	6090
Chemung and Susquehanna,	17¼	28,225	5880
Cayuga,	35	28,178	5870
Buffalo and State line,	69	25,963	5400
Hudson and Berkshire,	31½	25,364	5290
Syracuse and Utica,	53	23,346	4860
Utica and Schenectady,	78	23,257	4840
Long Island,	95	22,089	4600
Buffalo and Niagara,	22	20,568	4280
Saratoga and Schenectady,	22	20,502	4270
Canandaigua and Elmira,	46¾	20,259	4220
Watertown and Rome,	96	16,364	3390
Oswego and Syracuse,	35	15,787	3290
Buffalo and Corning,	44	14,751	3080
Plattsburg and Montreal,	23	14,573	3030

The latter items £3030 to £3390, are as much below the usual rates; as those of £10,000 per mile are above it; nevertheless, it is evident, a line nearly 100 miles, like the Watertown and Rome, can be constructed and equipped for £3400 per mile.

It will be useful to examine the various classes of expenditure. We shall begin with the heaviest, and take the New York and Erie, which is an example of a long line, extending 464½ miles. The cost is thus made up:—

	Dollars.	£.
Land, damages, and fencing,	1,968	410
Earthworks, bridges, &c.,	19,482	3966
Permanent way and rails,	8,763	1825
Stations,	1,915	398
Engineering, and preliminary expenses,	869	185
Total cost of line,	32,997	6870
Locomotives, carriages, &c.,	17,347	3618
Total cost,	50,344	10,488

The figures will not fit exactly, but they will be found sufficient for any useful comparison.

A large class of lines are constructed at about 30,000 dollars per mile. We will take the Buffalo and Rochester at 32,295 dollars.

	Dollars.	£.
Land and fencing,	5,228	1090
Earthworks, &c.,	7,000	1458
Bridges,	721	150
Permanent way, &c.,	14,172	1942
Stations,	623	130
Shops and machinery,	409	85
Engineering, &c.,	179	37
Total cost of line,	28,332	5902
Locomotives, carriages, &c.	3,963	839
Total cost,	32,295	6740

Another class of lines are those at 20,000 dollars. We shall take the Long Island Railway.

	Dollars.	£.
Land and fencing, . .	1,029	214
Earthworks, &c., .	6,203	1292
Bridges, . . .	134	28
Permanent way, &c., .	10,908	2271
Stations, . . .	120	25
Shops and machinery, .	424	88
Engineering, &c., . .	891	186
Total cost of line, .	18,710	3897
Locomotives, carriages, &c., .	3379	703
Total cost,	22,089	4600

We shall now take the cheapest lines, the example being the Watertown and Rome, 96 miles long.

	Dollars.	£.
Land and fencing, . .	1,083	225
Earthworks, &c., . .	6,413	1,335
Bridges, . . .	407	84
Permanent way, &c., .	5,480	1,141
Stations, . . .	377	78
Shops and machinery, .	239	49
Engineering, &c., . .	399	83
Total cost of line, .	14,399	2,999
Locomotives, carriages, &c., .	1,965	408
Total cost, .	16,364	3,407

The actual cost of construction of the several lines, is as follows:—

	Dollars.	£.
New York and Erie, . .	32,997	6870
Buffalo and Rochester, .	28,332	5901
Long Island, . .	18,710	3897
Watertown and Rome, .	14,399	2999

The cost of working plant is as follows:—

	Dollars.	£.
New York and Erie, . .	17,347	3618
Buffalo and Rochester, .	3,963	839
Long Island, . .	3,379	703
Watertown and Rome, .	1,965	408

The difference of cost between the New York and Erie, and the Buffalo and Rochester, is chiefly owing to the difference of cost of working plant, the former requiring for its heavier traffic more plant.

The work is regulated according to the traffic, and when the traffic admits of it, the works are of a larger and more expensive class, the rails heavier and the plant stronger.

The total length in New York State laid at the lowest rates, is 198 miles, and ranging from £3090 per mile, to £3390 per mile. In the teeth of such figures, it is impossible to say lines cannot be laid down in our colonies and India.

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*Trial of the Boomerang Screw Propeller.**

On Saturday last at half past seven, A. M., a trial trip with Sir Thomas Mitchell's boomerang propeller took place in Stoke's Bay, along the

* From the London Mechanic's Magazine, July, 1853.

measured mile, on board Her Majesty's ship *Conflict*, under the command of Captain Henderson, C. B., of Her Majesty's ship *Blenheim*.

The wind was strong at the time the *Conflict* reached her trying ground, amounting to from six to seven, or equal to about a quarter of a knot. The tide was opposed in one direction of the course, the wind in the other. After eight runs along the measured distance, the results were, on an average, 9·125 knots, with an average of 63¾ revolutions. This was somewhat surpassing in speed the result of the last trial with the common screw, with eight revolutions less, and a saving of one-eighth of the coal; and Sir Thomas Mitchell appeared to entertain no doubt that, had the pitch of the boomerang screw been the same as the pitch of the common screw, a higher speed would have been the result. The reduction of the vibration ordinarily experienced on board either screw or paddle steamers, and frequently a distressing annoyance, was noticed approvingly by all on board the *Conflict*. This comparative absence of vibration is one of the best characteristics of the boomerang, saving at once the wear and tear of the ship and the passengers' rest. The *Conflict*, however, is not a vessel the construction of which admits of her rapid propulsion, either by steam or canvas, as her trials in Commodore Martin's squadron, as set forth in the official report, sufficiently testify. This heaviness of the *Conflict* clearly accounts for the less brilliant result as to speed obtained with the boomerang than was formerly obtained with it at Liverpool and Sydney, on board vessels built on lines better adapted for speed. We were informed by one of the owners of the *Genova* (a Liverpool merchant ship, of which we noticed the trial with this propeller,) that on a recent voyage home from Quebec to Liverpool, the *Genova* had averaged a knot more per hour with the boomerang propeller than he had ever previously attained with a common screw, with not half the customary vibration.

The name "Boomerang" propeller has incited many inquiries as to what affinity, in nature as in name, this screw of the scientific Australian engineer and discoverer, Sir Thomas Mitchell, claims with the familiar though little understood missile of that name, of which such marvellous stories are told. In the hands of a native the boomerang certainly performs marvellous feats, while in those of an European it is inert or intractable. The savage, by practice, knows precisely how to poise as well as project his familiar missile, and in this secret, we apprehend, consists Sir Thomas Mitchell's application of the principle of the Australian missile to the propulsion of vessels. The balanced centre is the great feature connecting Sir Thomas Mitchell's screw and the boomerang, and upon this principle, judging by analogy, the efficiency of the arrangement very much depends. Other trials with Sir Thomas Mitchell's propeller are in contemplation, when we shall further notice the results obtained.

Another trial took place on Monday morning last. The *Conflict* left harbor at 9 A. M., for the measured mile in Stoke's Bay, when the average result of six runs was 9·378 knots, an improvement of about two-thirds of a knot on the speed attainable with the *Conflict's* own propeller. The average revolutions were 65¼.

This trial with the boomerang was made in order to test the action of the blades, after the two small continuations which Sir Thomas Mitchell

had been induced to make had been taken off, and the propeller reduced to its original shape and proportions. The result has been a gain of two-thirds of a knot, which nautical men consider a great deal with so heavy a ship as the *Conflict;* and we understand that Sir Thomas Mitchell means to challenge Griffith's propeller to do as much with the same ship.

The general result of the trials to which the boomerang has been subjected, seem to establish its claim to public favor. In point of celerity, Sir Thomas Mitchell has proved the efficiency of his boomerang in a very heavy vessel, and that efficiency will be more palpably manifest if his offer to fit one to Her Majesty's yacht the *Fairy* is accepted. In other points not so striking to superficial observers, perhaps, as celerity, but not less intrinsically important, namely, the diminished wear and tear of ships and the economy of fuel, the superiority of the boomerang is decided. We alluded to the absence of vibration in the trial we last reported; and on this occasion, in the midships of the vessel and below, while the *Conflict* was making nearly 10 knots, vibration could not be perceived. The enterprising merchants of Liverpool have shown themselves sensible of the economical advantages of the boomerang, and have already fitted it to several of their ships, which have accomplished quick voyages with a much diminished expenditure, as already noticed. The propeller used on board the *Conflict* was manufactured by Taylor & Co., of Birkenhead, and Sir Thomas Mitchell pronounced an emphatic eulogium on the skill of their workmen, and their ready appreciation of the principle of his invention, or rather his ingenious application of the principle of the rude Australian weapon to the purposes of propulsion. The leading and the following blades of the boomerang propeller may be likened to the dorsal and caudal fins of fishes when swimming, act on water at similar angles, and are rooted on the shaft on the same principle of strength as those fins are attached to the fish's body, imparting the power which is to give it motion. To give the boomerang propeller full space to develop its powers, larger apertures are requisite than are now generally found in either ships of the royal navy or in merchant vessels. The full boomerang propeller requires, we are informed, a space in length equal to one-third of the height. This alteration can, however, be easily effected.

AMERICAN PATENTS.

List of American Patents which issued from October 18, to November 8, 1853, (inclusive,) with Exemplifications by Charles M. Keller, *late Chief Examiner of Patents in the U. S. Patent Office.*

OCTOBER 18.

63. For an *Improvement in Propellers;* Ebenezer Beard, New Sharon, Maine.

Claim.—"What I claim is, the use of one or more flanches or arms, placed circumferentially upon the blades of a screw propeller, substantially in the manner and for the purpose described."

64. For an *Improvement in Sofa Beds;* Edwin B. Bowditch, New Haven, Conn.

"My invention consists in arranging the ordinary seat of a sofa, lounge, or other suitable article of furniture, and in such a manner that it can be turned up and back far enough to allow an under seat, which is hinged to the front rail of the sofa, with the upholstered

side down, to be turned out to the front, so as to come on a level with the ordinary seat, when said ordinary seat is let back into its place, thus forming a level bed."

Claim.—"What I claim is, the arrangement of hinging the ordinary sofa seat to the back rail of the sofa frame, in combination with the arrangement of hinging an under seat with the upholstered side down, to the front rail of the sofa, so that said under seat, by lifting the ordinary seat back, can be turned out of the front of and on a level with the ordinary seat, thus forming a bed. I also claim the arrangement of hinging the stuffed back to the top rail of the sofa, and attaching the back, at the bottom, to the top seat by strips of iron, in combination with the arrangement of hinging the top seat at the back lower corner."

65. For an *Improvement in Shuttle Motions for Power Looms;* William Crighton, Fall River, Mass.

"This invention consists in connecting the two pickers by means of a rigid rod or connexion passing through the lay, and giving motion to the same by a picker lever, which is operated upon to throw the shuttle in both directions by a single cam. The result obtained by this improvement is, the giving of the pickers a perfectly parallel motion, by simpler mechanism than that commonly employed for the purpose."

Claim.—"I do not claim operating the picker by a cam on a short shaft at the side of the loom; but what I claim is, connecting the two pickers with a rod or rigid connexion, which receives motion from a single lever and one cam, whereby both pickers are operated, as herein set forth."

66. For an *Improvement in Attaching Artificial Teeth to the Metallic Plate;* Henry L. Crider and David Williams, Lancaster, Ohio.

Claim.—"What we claim is, securing the artificial teeth to a plate by the usual method, and afterwards fastening said plate on the alveolar ridge of the plate having the impression of the mouth, either by riveting or the employment of soft solder, so as to prevent the application to the plate (having the impression) of the intense heat required to secure the teeth, as and for the purpose fully set forth."

67. For an *Improvement in Self-Winding Telegraphic Registers;* James J. Clarke, Philadelphia, Pennsylvania.

Claim.—"What I claim is, the combination of the winding magnet, the break-circuit wheel, and spring, with the train of wheels of an ordinary telegraph register, in the manner and for the purpose substantially as described."

68. For an *Improved Steering Apparatus;* Charles Flanders, Boston, Mass.

Claim.—"What I claim is, my combination and arrangement of the rope, the two sets of leading blocks, the sheaves in the after end of the tiller, with one another, the tiller and windlass, so as to operate together, and move the rudder, substantially in the manner, as specified."

69. For an *Improved Mode of Operating Mill Saws;* Benjamin Frazee, Durhamville, New York.

Claim.—"What I claim is, attaching a reciprocating saw blade to the main shaft, by means of a slotted lever and crank pin, operating in the manner and for the purposes substantially set forth."

70. For an *Improvement in Machines for making Railroad Chairs;* Robert Griffith, Newport, Ky., and Geo. Shields, Cincinnati, Ohio.

Claim.—"What we claim is, 1st, Hanging the fulcra of the clipping and bending levers eccentrically in boxes made capable of circular movement, for the purpose of adjusting the said levers to their work with facility and accuracy, substantially as specified. 2d, The method described of adjusting the angular set of the clipping and bending levers, by pivoting and adjustably connecting them to outer operative levers, essentially as set forth, and whereby a varied inclination may be given to the cutting and bending of the clip, to suit different thicknesses of blanks or forms of chair required."

71. For an *Improvement in Implements for Cutting Cloth;* Geo. W. Griswold, Carbondale, Pennsylvania.

Claim.—"What I claim is, stretching the cloth or other material to be cut over the two jaws of the stock, and holding it firmly in place by the clamp, whilst the knife divides it with a draw cut, substantially as described."

72. For an *Improvement in Instruments for Plotting;* Thomas Hinkley, Hallowell, Maine.

Claim.—"What I claim is, the method or means of obtaining in the above described machine a compound or resultant parallel motion, the same consisting in a combination of pinions or gears, and sunken racks, (or racks provided with parallel bars, as specified,) two sliding and rotary shafts, as arranged, connected, and supported, so as to operate together, substantially as described."

73. For an *Improvement in Cutting Boots;* Daniel Lynahon, Buffalo, New York.

Claim.—"What I claim is, the tongue, which first gives to the vamp a more exact crimped turn; secondly, covers the seam from being seen, and prevents it from ripping; and, thirdly, keeps the seams permanent, by receiving the strain that comes on them when drawing on the boot."

74. For an *Improvement in Power Looms;* William Mason, Taunton, Mass.

Claim.—"What I claim is, the method of operating the warp beam to let off the warps, and ease them in the opening of the shed, by means of the weighted cord acting on the periphery of a wheel geared to the warp beam, and receiving motion from an eccentric or its equivalent, substantially as specified, in combination with the mode of regulating the delivery motion by the action of the warps on a weighted whip roller, acting by a friction strap on the friction wheel on the let-off apparatus, substantially as and for the purpose specified."

75. For an *Improvement in Machines for Figuring Carpenters' Squares;* Norman Millington and Dennis J. George, Shaftsbury, Vermont.

Claim.—"What we claim is, the combination of the revolving chase wheel with the lateral moving anvil, by which the relative position of the square to be stamped and the required chase is so regulated that the line of the square to receive the impression is brought under the chase containing the desired figures, substantially as set forth."

76. For an *Improvement in Power Looms;* John Pender, Worcester, Mass.

Claim.—"What I claim is, the rest, in combination with the guides, when constructed substantially as described."

77. For an *Improvement in Looms for Weaving Fancy Goods;* Benjamin F. Rice, Clinton, Mass.

"The nature of my invention consists, first, in employing levers formed of two or more parts, one part of said levers being so constructed as to oscillate within the other part by the action of hooks and pins set in the grooves of a figuring chain, said hooks and pins acting upon the upper portion of the oscillating part of said levers, thereby causing the lower portion of the aforesaid oscillating part to move to and fro within the outer and larger part of said levers, thus forming a groove in which a vibrating roller is made to act upon the outer and larger part of said levers, which operation raises and depresses the harnesses in the manner hereafter to be described, whereby I am enabled to give a more positive action to the levers which act upon the harnesses when run at an unusual speed, and also to produce a uniform shed. The second part of my invention consists in giving motion to the figuring chain, by the use of a crown wheel turned by the action of a finger projecting from a vibrating lever, and working in the openings of the crown wheel, said vibrating lever receiving its motion from a crank connected to a disk wheel on the outer end of the main or crank shaft, thereby giving a positive motion to the figuring chain which carries the hooks and pins, and also to reverse the motion of the chain without the loss of the figure, when the main or crank shaft is reversed. The third part of my invention consists in constructing the bars which connect the links of the figuring chain in such a manner as to admit of the insertion of hooks or pins, the lower parts of which are made in the form of an inverted wedge; said bars are also provided with a slot or opening at one end, large enough to admit easily the insertion of the hooks or pins; the advantage thereby obtained is, that the hooks or pins are more easily adjusted, and also held more firmly in their position when placed."

Claim.—"Having described the construction and operation of my invention, and pointed out its modification, what I claim is, the application of compound levers, constructed substantially as herein described, to the raising and depressing of harnesses or heddles in the manner substantially as set forth. I also claim employing a finger attached to the vibrating lever, operating substantially as described, in combination with the crown wheel,

to move the figuring chain, substantially as specified. I also claim forming a groove in the bars of the figuring chain, for the insertion of hooks or pins, or their equivalents, in the manner substantially as specified."

78. For an *Improvement in Air Beds;* John Scott, Philadelphia, Pennsylvania.

Claim.—"What I claim is, forming a bed of an air-tight india rubber cloth sack, enclosed or enveloped in a pouch-formed mattress, composed of two thicknesses of ticking or other suitable material, between which is interposed feathers, hair, cotton, or other soft substance, retained by proper quilting; said mattress conforming to the shape and size of the air sack when extended with air by flexible pipes."

79. For an *Improved Life Preserving Bucket;* Nathan Thompson, Jr., Williamsburg New York.

Claim.—"I do not claim a double vessel, as such have been employed both as refrigerators and retainers of heat; but what I do claim is, 1st, A double vessel, the space between the outer and inner side thereof being filled with cork or its equivalent, by which it is in a great measure secured against leakage, and retains sufficient buoyancy when punctured, and serves as a reliable bucket and life preserver. 2d, I claim attaching the handle thereto by means of the tubes, the nicks in the handles, and the bending of the ends of the tubes therein, substantially in the manner described."

80. For an *Improved Life Preserving Seat;* Nathan Thompson, Jr., Williamsburg, N. Y

Claim.—"I do not claim a life preserving stool or seat in the general, as such have been for a long time in ordinary use; but what I do claim is, 1st, The folding life preserving seat, with a buoyant divided top, constructed substantially in the manner described. 2d, The clasp, in combination with the surfaces on which it slides, constructed substantially as described, and operating to hold the stool either shut or open, substantially as described."

81. For an *Improvement in Iron Car Bodies;* Thomas E. Warren, Troy, N. Y.

Claim.—"What I claim is, the combination of the hollow sheet metal columns and panels, as described, with the through bolts, holding the top, bottom, and sides all firmly together, in the manner and for the purpose set forth."

82. For an *Improvement in Carpet Stretchers;* J. W. Weatherby, Kingsville, Ohio.

Claim.—"I do not claim the invention of rack and pinion, or any of these parts separately of themselves, but the general construction and arrangement, by which I am enabled to save much time and labor, and also to perform the object in a more perfect manner than it can be done in the usual way. But what I do claim is, the general construction and arrangement of the carpet stretchers, made and operated as described."

83. For an *Improvement in Door Locks;* Linus Yale, Newport, New York.

Claim.—"What I claim is, introducing and applying the key from behind, instead ot in front, as is usual, by means of a permanent wrench, revolving key, chamber, and the passage, in the manner and for the purpose substantially the same as described."

84. For an *Improvement in the Application of High Pressure Engines to Screw Propellers;* Harry Whitaker, Buffalo, N. Y.

"The nature of my improvement consists in applying screw propellers and engines therefor to the sides of boats, in such manner that they can be worked by the direct application of the crank from the engine."

Claim.—"What I claim is, the direct application of the crank outside of the hull to side screw propellers, when such application is combined with or effected by a high pressure engine, arranged also outside of the hull, substantially as above set forth."

OCTOBER 25.

85. For an *Improved Window Shutter and Fastener;* Calvin Adams, Pittsburgh, Pa.

"My invention consists in attaching to, and combining with the latch or bolt of a shutter fastener, a contrivance for bowing the shutter; that is, securing it in its position when partially opened."

Claim.—"I do not claim the construction of the shutter fastener, nor the use of the latch and pin as used for fastening shutters when closed, nor otherwise than in combination with the contrivance for bowing shutters; but what I do claim is, the combining with the latch or bolt of an inside shutter fastener, a contrivance for securing the shutters in a partially opened position by means of the rings and the arm, in combination with th latch and pin, substantially in the manner and for the purpose set forth."

86. For an *Improvement in Self-Acting Bar Excavators;* G. T. Beauregard, N. Orleans, Louisiana.

Claim.—"What I claim is, the bar excavator, in which the surface current, by means of the inclined plane, is deflected downward, and made to act upon the bar, the whole being arranged and operated substantially as described."

87. For an *Improvement in Devices of a Convertible Dung Fork;* Ezra H. Dawes, Litchfield, Maine.

"The nature of my invention consists in attaching the tines of an ordinary dung fork to the handle by means of a joint, round which they are permitted to revolve in such a manner that they may be secured in one of two positions; the same instrument is thus made to serve a double purpose, and may be used either as an ordinary dung fork, or as a garden cultivator or prolonged hoe; or, having been made use of as an ordinary dung fork with which to load manure, it may be instantaneously shifted so as to serve the purpose of handling the manure from the cart into hills, or otherwise, as the case may require."

Claim.—"What I claim is, making the tines of ordinary dung or hay forks to revolve upon the handle, in the manner and for the purpose set forth."

88. For *Improvements in Propelling Vessels;* Frederic P. Dimpfel, Philadelphia, Pa.

Claim.—"What I claim is, the arrangement of the water passages, apertures, and valves, in combination with a reciprocating piston and its chamber, substantially in the manner and for the purposes set forth."

89. For an *Improvement in Lounges;* Augustus Eliaers, Boston, Massachusetts.

"My improvement in lounges, couches, or other articles of furniture in which it is desirable to vary the inclination of the back, consists in arranging the back or support to the upper part of the body upon springs, so that it can be inclined simply by the weight of the occupant at pleasure, the part which forms the support being attached to the body of the lounge by hinges, and being fastened in any desired position by a curved arm and set screw."

Claim.—"What I claim is, resting the part which forms the support to the upper part of the body in lounges, or other similar articles of furniture, upon springs and hinges, as above described, so as to vary its inclination at the pleasure of the occupant; the said support being fastened and held in any desired position, by a set screw and curved arm, as above set forth."

90. For an *Improvement in Library Step Chairs;* Augustus Eliaers, Boston, Mass.

Claim.—"What I claim is, a library step chair, or a chair which may be changed at pleasure into a flight of steps, in which the fold or hinge of the two parts is formed in the top, or an extension of the front leg of the chair, thereby permitting the seat to be so stuffed as to form an ornamental and comfortable chair, and when opened, to form a flight of five steps, as set forth."

91. For an *Improvement in Bee Hives;* Wooster A. Flanders, Sharon, Vermont.

Claim.—"It is evident that my invention may be carried out in a great variety of ways; I do not therefore confine myself to the peculiar construction above described; but what I claim is, the adjustable passage, by which the entrance to the hive may be enlarged or diminished, in manner and for the purpose substantially as set forth."

92. For an *Improvement in Attaching Horses to Ploughs;* John D. Filkins and Wm. H. De Puy, Lima, Indiana.

Claim.—"What we claim is, the combination of the limber and stiff tongues with the running gear, to adapt it to being drawn by two teams abreast, as described."

93. For an *Improvement in Cutting and Planting Potatoes;* Samuel Hutchinson, Rockport, Indiana.

Claim.—"What I claim is, the construction and combination, as herein described, of cam, sliding platform, cutting blade, and trap doors, with the furrowing share and covering blade, for the purpose of cutting, dropping, distancing, and covering potatoes."

94. For an *Improvement in Winnowers;* David S. Mackey and Jarvis R. Smith, Batavia, New York.

"The nature of our invention consists, 1st, In a peculiar manner of operating the screen, viz: by means of two eccentrics working between blocks attached to the underside of the

screen. 2d, In having two blasts proceed from a single fan, said blasts crossing each other, and being so arranged that the grain is subjected to one of the blasts before passing through the screen, while the other blast prevents the screen from being clogged with chaff and other matter."

Claim.—"What we claim is, 1st, The peculiar manner of opening the screen, viz: by means of the eccentrics placed in a reverse manner upon the shaft, said eccentrics working between the blocks attached to the underside of the screen, as shown and described. 2d, Producing two blasts from a single fan, as shown, and having the two blasts cross or intersect each other, by which a blast passes horizontally over the top of the screen, and a blast also passes upward through the screen, preventing the screen from being clogged or choked by the chaff."

95. For an *Improvement in Machines for Dressing Stone;* E. G. Matthews, Troy, New York.

Claim.—"What I claim is, 1st, The driving apparatus for driving the cutters, said apparatus being formed and constructed of the driving wheel and friction wheel, arranged substantially as herein specified, in the frame attached to the driving rod, by means of which rod a reciprocating motion is given to the said frame, which causes the driving wheel to roll back and forth, on and over the heads of the cutter stocks, thereby causing the cutters to make the desired cut in the stone, the friction wheel meanwhile rolling on the periphery of the driving wheel, and also in a groove in the cross bar, as before described. I do not intend to confine or limit myself in this claim, exclusively to the use of one friction wheel, but hold myself at liberty to use one or more, and to vary the arrangement of them, while the principle of driving the cutters as herein described and shown is substantially adhered to. 2d, I claim the rocking bar, with inclined planes at each end, in combination with the cutter stocks and the roller, or its mechanical equivalent, attached to the frame of the driving apparatus, for the purpose of rolling or striking on the inclined planes of the bar as the driving apparatus reaches the end of its stroke, so as to rock or tip the bar, thereby causing the inner edge of the bar to catch or stroke under the shoulders in the cutter stocks, and raise them up in position for the driving wheel to act upon them in its return stroke, substantially as herein specified."

96. For an *Improvement in Ships' Side Lights;* Charles Perley, City of New York.

"The nature of my invention consists in the use of a circular glass or light, enclosed by a frame, on which are cogs or teeth gearing into a fixed rack on the inside of a metal box that is let into the side of a vessel. To open the light it is rolled to one side within the box or case, and when it is to be closed the light is rolled back again, and a screw ring forced into an elastic packing in the frame of the glass, makes a tight joint, and any water that by accident may run into the box in which the light rolls, can escape by a small opening left in the lower part for the purpose, thereby entirely preventing any leakage from entering the ship."

Claim.—"I do not claim sliding a glass or light sideways in a frame, as that has been done; but I am not aware that any box has been so fitted as to contain a side light and form a receptacle for leakage, passing the same out by a small hole or holes, thereby effectually preventing any water from passing into the ship. I am aware that india rubber has been used as a packing for side lights; therefore I do not claim the same. What I do claim is, 1st, The means herein described and shown, for preventing any leakage from a side light passing into a vessel, by enclosing the side light in a metallic box let into the side of the vessel, and provided with a small hole or holes to pass out said leakage, as specified."

97. For an *Improved Valve Gauge for Bottles;* Alphonse Quantin, Philadelphia, Pa.

Claim.—"What I claim is, the above described machine or gauge, with the arrangement of the valves, as herein before described, one opening by the act of closing the other, so as to pour out of the vessel to which the gauge is attached, only the quantities of liquid contained in the space between the two valves."

98. For *Improvements in Metallic Piston Packing;* Henry L. Russell, Hudson, Mich.

"The invention consists in expanding a number of metallic bands by means of levers secured in the periphery of a drum, and operated by means of a ring fitted within said drum, and arranged as will be hereafter shown."

Claim.—"I do not claim the metallic bands, for they are now used in metallic packing; but what I do claim is, expanding the metallic bands which encompass the drum by means of the levers placed in the periphery of the drum, and operated by means of the ring within

the drum, as herein shown and described, the ring being prevented from moving casually, by means of the coil spring, and ratchet and pawl, or their equivalents."

99. For an *Improvement in Making Shovels, Spades, &c.;* William Richards, Philadelphia, Pennsylvania.

Claim.—"I claim the manufacture of shovels, spades, and other instruments made of a composite sheet of metal, whose constituents are parallel laminæ of unequal hardness, as herein set forth; but I make no claim to such implements made of the hard laminæ extending for a short distance only above the edge, but only where it extends up beneath the strap to support the back."

100. For an *Improvement in Expanding Horse Shoes;* Benjamin Perry Sargent, Sutton, New Hampshire.

"The nature of the principal part of my invention consists in making the quarters of the shoe separate from each other, and uniting them together, or to a toe bar, by means of one or two joints, and providing the quarters with one or more expanding screws, by which, when they are secured to the foot of the animal, they may be expanded or moved apart from each other."

Claim.—"What I claim is, the combination of the bearers or ears with the jointed quarters or bars, jointed together, or to a common toe piece or cork, and operated by an expansion screw or contrivance, as specified."

101. For an *Improvement in Garden and other Hoes;* Jacob T. Sargent, Sutton, New Hampshire.

Claim.—"I do not claim the employment of a screw and nut for confining two things together; nor do I claim the attachment of the shank and blade of a hoe by means of the bearing plates welded to and forming part of the shank, and riveted to the blade; but what I do claim is, my improved attachment of the blade and shank, whereby the blade not only can be readily removed from, or as readily confined to the shank, but when affixed to it is prevented from breakage where the greatest leverage or strain is brought upon it; meaning to claim the bearing head fixed firmly to, and making part of the shank, the movable plate or stiffener, or its equivalents, (applied to the back of the blade, and made separate from the shank,) the screw on the shank, the screw nut, and the recess in the hoe blade, as combined together and with the shank of the handle, and made to operate substantially as specified."

102. For an *Improvement in Spring Clamps for Clothes Lines;* David M. Smith, Springfield, Vermont.

Claim.—"I do not claim a mere clasp composed of two levers hinged together between their respective ends, and having a spring placed between their two adjacent arms; but what I claim is, the above described improved clothes pin; that is to say, I claim the arrangement of the line opening and the spring on opposite sides of the hinge of the two levers, all substantially as herein before specified, whereby, by pressure of the longer legs of the levers between the thumb and fingers of the hand of a person, the instrument is rendered very convenient of application, without danger during the same of tearing the clothes secured by it on a line."

103. For *Improvements in Propellers;* James Trees, Salem, Pennsylvania.

Claim.—"What I claim is, the combination with submerged propellers, whose area, where the water enters, is greater than the hinder extremity where the water escapes, of helical blades or vanes, and a tapering shaft, to which they are attached, both the blades and shafts tapering from point to rear, substantially in the manner and for the purpose set forth."

104. For an *Improvement in Ox Yokes;* Albert Vose, Pittsfield, Vermont; ante-dated August 10, 1853.

Claim.—"What I claim is, 1st, The construction of the semi-revolving neck blocks, each having a curved groove and pin fitting into it, for enabling the neck block to always adjust itself at right angles to the direction of the neck of the animal. 2d, I claim, in combination with the groove in the neck block, the use of the pin, subserving the double purpose of controlling the movement of the neck block, and adjusting the length of the yoke, substantially as described."

105. For *Improvements in Cutting Bars and Teeth of Curry Combs;* Wm. Wheeler, West Poultney, Vermont, Assignor to Charles H. Kellog, Troy, New York.

Claim.—"What I claim is, the method of forming the bars of curry combs by punching them out of plates, so that at a single operation, a strip of the proper width for the bar is severed from the plate, and one row of teeth cut thereon, and another row upon the end of the plate for the next bar, substantially as set forth."

106. For an *Improvement in Soda Fountains;* Wm. Coughlan, Baltimore, Maryland.

"The nature of my invention consists in adding an auxiliary faucet or valve, whereby I am enabled to quickly fill the fount with mineral water already prepared in convenient stationary apparatus."

Claim.—"What I claim is, the auxiliary or valve, for the purpose of enabling the fount to be filled with prepared mineral water, substantially as described."

107. For an *Improvement in Attaching the Head Cringle to the Yards of Vessels;* Nelson Crocker, Sandwich, Massachusetts.

Claim.—"What I claim is, the head cringle hooks and their fixtures, constructed and combined with rigging of a vessel, substantially in the manner and for the purpose set forth."

108. For an *Improvement in Seed Planters;* Nathan C. Davis, West Jefferson, Ohio.

Claim.—"What I claim is, the piston provided with a notch or hollow in its upper end, and so arranged in combination with the partition and depression, that it will bring up and discharge through the aperture the desired number of grains of corn every time it is raised by the operator, substantially in the manner set forth."

109. For an *Improvement in Machine Hammers;* Daniel Noyes, Abington, Mass.

"The essential features of my improvements consist in a novel arrangement of mechanical devices for hammering or forging iron, whereby it can be brought into any desired shape or form much more expeditiously and with much greater regularity than by any of the modes commonly practised in trip hammers for the purpose. This result I effect by means of hammers, which are so placed and actuated as to strike the iron to be shaped both on the top and on the two sides, the upper hammer having motion imparted to it from a crank on the main driving shaft, and the two side hammers moving horizontally, so as to strike the sides of the piece to be forged."

Claim.—"What I claim is, 1st, A machine for hammering iron, &c., having the distinguishing features herein above enumerated, viz: a hammer for giving the blow upon the upper surface of the iron, acting in conjunction with two hammers which simultaneously strike the sides of the iron, substantially as above set forth; and I further claim, in a machine for hammering iron, the use of these two side hammers operating as specified, whether used in connexion with the upper hammer, or without it. 2d, I claim so arranging the relative position of the fulcra of the hammer beams, and the ends of the connecting rods attached to said beams, and to the crank shaft and gears from which they derive their motion, as to bring the said fulcra and connecting rods in nearly a straight line at the time of giving the blow for the purpose above specified, the opposite ends of the connecting rods, just before giving the blow, moving in opposite directions, so as to give a rapid and powerful blow. 3d, I claim causing the anvil to descend from the iron just before the blow of the side hammers, and to ascend just before the blow of the upper hammer, by means of a rod attached at one end to the under side of the upper hammer beam, and at the other end to a tilting arm, which embraces the anvil, substantially as above described."

110. For *Improvements in Screw Nails;* Samuel Pratt, Boston, Massachusetts.

Claim.—"What I claim is, a screw nail constructed with a thread, shaped substantially as described. I also claim shaping the head substantially as set forth, so that the battering caused by the driving will not obstruct the application of the turn screw."

111. For an *Improved Spark Arrester;* Samuel Sweet, City of New York.

Claim.—"I desire it to be understood that I make no claim to originality of invention in the individual parts of the spark arrester, separately considered; but what I do claim is, the combination of the reticulated inverted frustrums of cones, constructed and situated as described, with the trumpet-shaped deflector and guard, the reticulated cylinder under the opening provided with the reticulated valve, when these parts are arranged in the upper

portion of an enlarged or expanded external pipe, such as that represented, the whole operating in the manner and for the purpose set forth."

112. For an *Improvement in Looms for making Weavers' Harness;* Kasimer Vogel, Chelsea, Mass.

Claim.—"I wish it to be understood that I do not confine myself to the precise details herein before set forth; but what I claim is, the combination of the loom for weaving the borders of the harness, with the press for securing the metallic eye upon the threads of the harness without a knot braid or loop, substantially in the manner described."

Re-Issue for October, 1853.

1. For an *Improvement in Spark and Gas Consumers;* David Matthew, Philadelphia, Pennsylvania, October 4.

Claim.—"What I claim is, the manner in which I have constructed and arranged the respective parts that constitute the inner and outer cases of the apparatus, which is placed at the top of the chimney. Also, I claim the manner of constructing and arranging the trumpet-mouthed tube within the inner case, said tube being divided into two or more parts, and being made to deposite and discharge the larger portion of the sparks by the aid of the opening between said parts, as described, substantially as set forth. I also claim the manner in which I connect the apparatus at the top of the chimney with the furnace or fire box, by means of the tubes or pipes, the cases, and the openings thence into the fire box or furnace, for the purpose made known. I likewise claim the manner of preventing the entrance of water into the fire chamber by the employment of the tubes, in combination with the tubes."

Designs for October, 1853.

1. For a *Bedstead;* John H. Barth, Indianapolis, October 4.

Claim.—"What I claim is, the design, configuration, and arrangement of the several ornaments and mouldings on the posts, rails, head, foot, and side boards and cornice, as fully set forth."

2. For a *Cooking Stove;* Julius Holzer, Assignor to North, Chase & North, Philadelphia, Pennsylvania, October 4.

Claim.—"What I claim is, the use of the ornaments and null mouldings described."

3. For *Stoves;* George H. Fryday, County of Philadelphia, Assignor to North, Chase & North, Philadelphia, Pennsylvania, October 4.

Claim.—"What I claim is, the design and configuration of the ornamental screen and standards, and the combination of the same with the ornamental base and the cylinder, as described."

4. For *Stoves;* Garrettson Smith & Henry Brown, County of Philadelphia, Assignors to North, Chase & North, Philadelphia, Pennsylvania, October 4.

Claim.—"What we claim is, the design and configuration of the mouldings and ornamental work, as described."

5. For *Cooking Stoves;* Hosea H. Huntley, Assignor to Daniel F. Goodhue, Cincinnati, Ohio, October 4.

Claim.—"What I claim is, the combination and arrangement of the ornamental forms and configurations of a cooking stove."

6. For *Stoves;* Garrettson Smith and Henry Brown, Assignors to C. W. Warnick & F. Liebrandt, Philadelphia, Pennsylvania, October 4.

Claim.—"What we claim is, the design, configuration, and arrangement of the ornaments in bas relief and mouldings set forth."

7. For *Metallic Coffins;* Theodore J. Gillies, Willliamsburgh, New York, October 11.

Claim.—"What I claim is, the design of the shape and configuration of the coffin, as described."

8. For *Cooking Stoves;* N. Putnam Richardson, Portland, Maine, October 25.

Claim.—"What I claim is, the general ornamental design of the stove, as shown in the side and front plates, including the legs, and as represented in the accompanying drawings; and separately I claim the ornamental design of the oven door, that of each of the front doors, that of the front, that of the door, that of the panel."

9. For a *Register;* Joseph A. Read, Assignor to William W. and Charles M. Atkins, Philadelphia, Pennsylvania, October 25.

Claim.—"What I claim is, the design, configuration, and arrangement of the ornaments in bas relief on the slide and plate, as set forth."

NOVEMBER 1.

1. For *Improved Protecting Bulwarks for War Vessels;* William Ballard, City of New York.

Claim.—"What I claim is, the use of the shield board, in combination with the bulwarks of a ship, substantially as set forth. Also, the use of the stanchions and panels, in combination with the deck of the vessel and the shield board, for the purposes and principle of construction and operation, substantially as set forth."

2. For an *Improvement in Magneto-Electric Machines;* Calvin Carpenter, Jr., Pawtucket, Massachusetts; patented in France, April 18, 1853.

Claim.—"I do not claim the employment of permanent magnets of helical coils of wire of metallic segments, upon a cylinder of non-conducting material, or of springs such as I have described, either separately or in combination, for the purposes set forth, otherwise than in the manner in which I have arranged, connected, and combined them; but what I claim is, the combination of one or more series of permanent magnets, radially arranged; the poles of each series being in one plane, and in two concentric circles, with a disk or disks of helices arranged in three sets, in such manner that the three sets may be acted upon successively, at nearly equal intervals of time; one set by the inner circle of poles, and the other two sets by the outer circle of poles; the currents of the several sets of helices being thrown into one constant or uninterrupted current by means of the current dischargers and springs, or their equivalents, as herein described."

3. For an *Improvement in Car Couplings;* A. P. Chatham, Canoga, New York.

Claim.—"What I claim is, constructing the buffer with a recess to hold the link in the proper position for entering the buffer, and the buffer with a cavity and uninclined draft catch, extending to nearly the top of its cavity, so that when a link is connected to the buffer, and pressed over the catch of the buffer, it cannot jump up and become detached from the catch while the cars are in motion; whereby the danger of the cars being separated while running, is greatly lessened, while the coupling is simple, cheap, and not liable to get out of order."

4. For an *Improved Pen and Pencil Case;* Gilbert S. Clark, City of New York.

"The nature of my invention consists in a peculiar arrangement of the pen and pencil slides, whereby I obtain an extension case for both pen and pencil, and am enabled to shove from the case either the pen or pencil, as occasion may require."

Claim.—"I claim neither the pen or pencil slide separately, for both have been previously used; but what I do claim is, the peculiar arrangement of the pen and pencil slides, as herein shown and described, viz: having the pencil slide with its covering tube placed within the pen slide or the tubes, and operating the two slides independently of each other, in the manner as set forth."

5. For an *Improvement in Cane and Maize Cutters;* John W. Cormack, Quincy, Ill.

Claim.—"What I claim is, the framing, and manner of attaching the knife and arm to the sled."

6. For *Improvements in Condensers for Steam Engines;* Benjamin Crawford, Pittsburgh, Pennsylvania.

Claim.—"What I claim is, the arrangement of the tubes or passages in the condenser with the inlet and outlet openings in the case, substantially as specified, so that a current of cold water is caused to flow round both ends of the tubes, whereby the condenser is prevented from undue heating, and the tubes kept coolest at both ends, and warmest at the middle, whereby the great bulk of the heat is transferred to the condensing water near

the point at which it is discharged from the case. 2d, Constructing the case of the condenser with stuffed, or other equivalent joints, to render it flexible, and thereby prevent fracture."

7. For *Improvements in Machines for Sticking Pins;* Chauncey O. Crosby, New Haven, Connecticut.

Claim.—"I am aware that conical rollers have been used for forming the inclined channel for conducting the pins, and that a screw has been used to separate the pins, and that players have been used in the manufacture of pins, and that clamping bars have been used for clamping the paper after it has been crimped, and that the paper has been drawn through and rolled up by a revolving cylinder, so graduated as to regulate the quantity of paper as to folding up; I therefore do not claim either of these as such, as my invention. But what I claim is, the method of crimping the paper by means of movable folding blades, in combination with the bed plate, while the back and front sides of the paper are sustained by the damping bars, substantially as herein described. 2d, I also claim the method of crimping the paper by means of moving folding blades, descending and ascending between the stationary and moving clamping bars, when the clamping bars serve as a part of the crimping apparatus, whether the paper be sustained by a bed plate or otherwise, when constructed and operating substantially as herein described. 3d, I also claim the method of lifting the pins from the distributor, and carrying them away and sticking them into the crimped paper, while the distributor is bringing another supply of pins in front of the clamping bars; thereby keeping the lifting players or other lifting apparatus continually in operation, when performed by the means and in the manner substantially as herein described. 4th, I also claim the lifting apparatus, or any substantial part thereof, when constructed, combined, and made to operate substantially as herein described. 5th, I also claim the combination of the lifting apparatus herein described, with the inclined transverse notches in the stationary clamping bar, by which means the pins will always stick in an exact line, even though the pins are not straight, when constructed, combined, and made to operate substantially as herein described. 6th, I also claim the combination of the conical rollers with the side planes, to form a straight, inclined, conducting channel, when combined, constructed, and made to operate, substantially as herein described. 7th, I also claim the lifting players, when constructed and made to operate substantially as herein described, either with or without the creeper, sliding guide, or director."

8. For *Improvements in Machines for Sticking Pins;* Chauncey O. Crosby, New Haven, Connecticut.

"My improvement consists in the use of twenty (or any other number,) of straight, inclined, conducting channels, to arrange and conduct the pins, with a slotted plate, or slide, to receive them at the lower end of the channels, and convey them to an equal number of spaces in an inclined or triangular block, through which they fall into horizontal grooves, and by an equal number of punches sliding in those grooves, to force the pins into the crimped paper."

Claim.—"I do not claim the channels nor grooves, nor the punches working in the grooves, nor the use of clamping bars to serve also as crimping bars, because these have all been used before, or claimed in my former application; but what I do claim is, the combination of the punches, (working in horizontal grooves,) with the slide, and the straight, inclined channels, when arranged and combined substantially as herein set forth. I also claim the combination of the punches with the double folding blades, when these are combined with the movable and stationary clamping bars, and the whole is constructed and combined substantially as herein described. I also claim the method of crimping the paper by means of folding blades, working between stationary and moving clamping bars, when those clamping bars serve as a part of the crimping apparatus, when constructed and operating substantially as herein described. I also claim the bars, (forming the side guides to the spaces,) to guide the pins while falling down from the separator to the horizontal grooves, in combination with the grooves and punches, when they are constructed, combined, and arranged, and used for the purposes substantially as herein described."

9. For *Improvements in Machines for Sticking Pins;* Chauncey O. Crosby, New Haven, Connecticut.

Claim.—"What I claim is, the use of a split wheel to connect the lower end of the straight, inclined, conducting channel, with the upper end of the vertical side guides, to convey the pins from the former to the latter, while it changes the position of the pins

from vertical to horizontal, as herein described, whether with or without the counter sinks in the inner edges of the peripheries. I also claim the use of a separating wheel, with teeth on its periphery, to sustain the column of pins, separate them, and drop them separately into the grooves in the sliding bed at the proper time, by its revolution, as herein described, whether the wheel be made of the two disks, or with the periphery grooved out, or the periphery be single, and the teeth cut directly across it. I also claim the method of crimping the paper by the use of jaws, with a tongue between them, to slide across the paper in such a manner that the paper may be crimped by double folding blades, forcing the two folds of the paper through the space between the tongue and the jaw on each side, so that the pins may be stuck through the crimps over the upper edges of the folding blades, while the tongue will be between the pins and the paper, and so that both the bars and tongue, and the double folding blades may be readily withdrawn, to release the paper; and this, whether the double folding blades are below or above the jaws and tongue, when they are constructed and used, and made to operate, substantially as herein described."

10. For a *Hose Protector;* David Demarest, City of New York.

Claim.—"What I claim is, the employment of a portable section of a rail track, constructed substantially as described, and with an opening in its centre for the hose to fit in, when said section is placed over said hose, the same being employed in the manner described, and for the purpose of covering the hose at certain points, and saving them from the great injury they sustain from carriages and cars passing over them during the time of fires, &c., as set forth."

11. For an *Improvement in Car Wheels;* Joseph Farnsworth, Jr., Madison, Indiana.

Claim.—"I am aware that P. W. Gates made a cast iron car wheel, in which the rim is connected to the central parts by two sets of short spokes; but this (without admitting its priority to my invention) I do not claim, as my improvement relates exclusively to the class of wheels in which a disk extends from the hub to the rim; my object being to support the rim and strengthen the disk by flexible supports, which will perform their duty without straining and endangering the breaking of the disk, as in the case of the wheels of this class before mentioned. Therefore, what I claim is, a cast iron car wheel, constructed as herein described; but I make no claim to any part of the wheel by itself, nor to any other combination of parts than that above set forth."

12. For *Improvements in Regulating the Speed of Steam Engines;* Luther R. Faught, Macon, Georgia.

"The nature of my invention consists in causing the cut-off to move with the valve by means of friction produced between them by suitable means, and attaching the former to a pendulum or other device, which is capable of offering to its movement a resistance which causes it to move a shorter distance than the valve, and thus close the steam openings of the valve, and cut off the steam before the termination of the stroke of the engine, and which increases or diminishes with the increase or diminution of speed of the engine, so as to close the passages and cut off the steam earlier or later, as may be required, and thus regulate the speed of the engine."

Claim.—"I do not confine myself to the employment of a pendulum or air spring, as there may be other devices that would produce analogous effects; neither do I confine myself to the precise methods of producing friction, herein described, as both the methods that I have shown are well known, viz: by the pressure of the steam in the valve chest, and by plates compressed to the rod by a spring; nor do I confine myself to the adjustment of the relation between the pendulum and the device or devices which produce the friction, as it will be evident that the lengthening or shortening of the pendulum will produce the same effect; but what I do claim is, connecting the cut-off with the slide valve, so that the latter drives the former by friction, when the cut-off is at the same time connected with a pendulum air spring, or some other device, offering such a resistance to its movement as will prevent its moving the same distance as the valve, and arrest it at such a point in the motion of the valve as to cut off the steam at the desired point in the stroke, and will increase or diminish with any increase or diminution of the speed of the engine, and thereby retard the motion of the cut-off more or less, in order to cut off the steam earlier or later in the stroke, and thus regulate the speed, substantially as described."

13. For an *Improvement in Grain Cradles;* Christopher P. Kelsey, Livingstonville, New York.

"My invention consists in so constructing the cradle, that not only shall the workman

be enabled to lay the grain more regularly, to cut the entire length of the scythe, and to readily adjust the set, or 'hover,' of the fingers, as compared with the snath and scythe; but also, that the implement shall balance better in the hands, and shall be capable of being folded closely together, when not in use, whereby it may be more easily transported, or stowed away, as the case may be."

Claim.—"What I claim is, 1st, The bar, or its equivalent, for attaching the frame of fingers to the snath, for the purposes set forth. 2d, So connecting the braces with the fingers, by means of link or other universal joints, that the snath may be folded close against the fingers, without requiring that the said braces shall be loosened in the snath; the whole being constructed and operating substantially in the manner set forth."

14. For an *Improvement in Coating Sheets of Metal;* Edmund Morewood and George Rogers, London, England.

"Our improved apparatus consists of a metallic vessel, having a flanch round its top, to give it the requisite strength; this vessel should be made of wrought iron, and of a length somewhat greater than the longest sheets to be coated, and of such a depth, that these sheets can be immersed in the bath of melted metal, at least eight or ten inches, when standing on edge."

Claim.—"What we claim is, the method herein described, of coating sheets of metal, by immersing them in other molten metals, which are more fusible, by means of rollers, arranged substantially as herein described; so that with the same machine, sheets of metal, varying in thickness, may be coated, free from puckers, bends, or indentations, on their surfaces,—thus rendering unnecessary, the subsequent operation of flattening, which heretofore could not be dispensed with."

15. For an *Improvement in Adjustable Springs for Carriages;* Russell S. Morse, Dixfield, Maine.

Claim.—"What I claim is, the adjustable auxiliary springs, in combination with the bed spring (or springs), substantially in the manner and for the purpose herein set forth."

16. For *Carpenters' Brace and Bit Fastener;* Howard Perkins, North Bridgewater, Massachusetts.

Claim.—"What I claim is, the manner of constructing and fastening the bit into the socket by the slide-lock, as described, having the end of the bit so formed, as to fit into the groove in the key, as set forth, and having the end of the bit press down upon the key, so that when the key is slipped back, the bit may be easily removed."

17. For an *Improved Gold Washer;* Henry M. Ritterband, City of New York.

Claim.—"What I claim is, the combination of the tube, valve, and lip, constructed and having the relative proportions substantially as described, forming an apparatus for removing earth and stones from auriferous earth, as specified."

18. For an *Improvement in Straw and Grain Separators;* John A. Taplin, Fishkill, New York.

Claim.—"What I claim is, the vibrating straw carrier and grain separator, as herein set forth, with a screen and fluted bottom board, for the purpose of separating the grain from the straw—returning the former to the winnowing apparatus, and conveying the straw to the hinder extremity of the machine."

19. For an *Improvement in Metallic Pens;* William H. Towers, Philadelphia, Pa.

Claim.—"What I claim is, making metallic pens, with depressions or cavities for retaining the requisite quantity of ink to supply the same, and making them flat on both surfaces, and tapering the shank or main body of the same, and inserting it in a corresponding socket or opening in the centre of the lower end of the pen holder, substantially in the manner and for the purpose set forth."

20. For an *Improved Machine for Turning Cylinders of Wood;* Increase S. Waite, Hubbardston, Massachusetts.

Claim.—"What I claim is, the combination, composed of the feeding hopper, the series of rotary mandrels and centres, applied to the shaft; the revolving cutter or cutter cylinder, the mechanism for giving to each mandrel an endwise movement, backwards and forwards, as described; mechanism for arresting the rotary movement of the shaft, or the heads, during the time necessary for the operation of the cutter or cutter wheel, on each piece of wood; and, finally, a mechanism for rotating the shaft and its two heads, all sub-

stantially as above described; the mechanism for moving each mandrel endwise, in manner and for the purpose described, being the spring, the wheel, and cam-plate, as described; that for rotating the mandrel, being the gear, and the gear on the shaft, put in revolution as described; that for arresting the rotation of the shaft, during the time necessary to turn down an article, being the stud, stop-plate, and the screw applied to each mandrel, and made to operate as specified; and, finally, that for rotating the shaft, being the friction roller, made to operate against the periphery of the circular head, and to be rotated and borne against said head, as set forth."

21. For *Improvements in Generating and Condensing Steam;* Peter H. Watson, Washington, District of Columbia; ante-dated May 2, 1853.

Claim.—"What I claim is, the method of recovering the heat of the exhaust steam by passing it through the comparatively cool water in the lower portion of the boiler, substantially as set forth. I also claim the arrangement of the upper end of the drop flues in an inclined plate, to facilitate the entrance of the smoke into the flues, and the passage of the steam from beneath the inclined plate into the upper part of the boiler, substantially as set forth."

22. For an *Improvement in Grain Separators;* Jacob V. A. Wemple, Chicago, Ill.

Claim.—"What I claim is, the employment of a cylinder, having tangential or other suitably projecting plates across or along its periphery, for the purpose of separating the grain, and breaking the impinging effect produced by the threshing cylinder on the endless apron, the said cylinder being so situated and operating in rear of the threshing cylinder, as gently to feed over it the straw and headings as they are delivered from the threshing cylinder."

23. For an *Improvement in Bee Hives;* Geo. Calvert, Upperville, Virginia.

Claim.—"What I claim is, the combination of the honey boxes with the box and cross pieces, arranged and operated in the manner and for the purposes set forth."

24. For an *Improvement in Devices for Steering Cultivators;* Seneca Lapham, Salem, Ohio.

Claim.—"What I claim is, the combination and arrangement of the parts, consisting of the lever and its attachment to the brace, and the connexion of the tongue to the lever by the staple; this I claim in its application to the purpose of changing the direction of this and other machines, as specified."

25. For an *Improvement in Fluid Metres;* Wm. B. Leonard, City of New York.

Claim.—"What I claim is, the combination in fluid metres, of mechanism for measuring the volume of a flowing fluid, however variable; mechanism for measuring the velocity of the flowing fluid, however that may vary; mechanism for multiplying these two quantities together; and mechanism for recording the product in such manner as to show on a register the quantity of fluid that has passed, as set forth. I also claim the combination of a self-acting guard valve or valves, however constructed or arranged, with the water wheel or other motor, in a metre, in such manner that the flow of water through the metre will be arrested, whenever its pressure is not sufficient to give motion to the motor the instant it begins to flow, whereby the escape of water through the metre, unmeasured, is prevented."

26. For an *Improved Mode of Opening and Closing Gates;* Wm. T. Merritt, Hart's Village, New York.

Claim.—"What I claim is, the method of elevating or depressing, or opening and closing the gate, as herein shown and described, viz: by means of the shaft having upon it the pulleys, the pulleys being attached permanently to said shaft, and having ropes attached to them; and the pulleys being placed loosely on the shaft, and connected to it at a certain period by means of pins on the shaft, working in slots in the bosses or hubs of the pulleys; the said pulleys having the chains attached to them and to the upper ends of the gate styles; and also the chains with the weights, the said chains being attached to the lower ends of the styles; the gate being prevented from being casually depressed, by means of the pawl, which is freed from the notch in the boss or hub by the dog, substantially as set forth."

27. For an *Improvement in Machines for Straightening and Curving Rails;* George Williston, Brunswick, Maine.

"The nature of my invention consists in placing over the part of the rail which is bent,

(by the weight of the train in passing,) a curved beam, which has its bearings on the rail near the end of the beam; then, by a contrivance which embraces the rail, I turn a screw, which has power sufficient to raise the bent portion to its original position, where it may be secured."

Claim.—"I am aware that a machine has been used in Bavaria, which acts by the pressure of a screw upon the bar to be bent; the bearing or platform being placed underneath the bar; this mode of action I do not claim; but what I do claim is, the combination of the screw, strap, beam, and slides, constructed and combined substantially in the manner described, with the beam placed on the top or side of the rail, for the purpose of straightening or curving rails on railroads, without the necessity of removing the same from the sleepers."

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28. For an *Improvement in the Cutting Gear of Grain and Grass Harvesters;* Sam'l. S. Allen, Salem, New Jersey.

Claim.—"What I claim is, the arrangement by which the driving wheel is made the centre of oscillation in counterbalancing the cutter beam and cutters thereon, embracing the secondary wheel and spring, for the purpose set forth. I also claim the combination of the tongue with the driving wheel and secondary wheel, for the purposes set forth. I also claim the method of balancing the cutter blades on the angular bar by the sliding bar, in combination with the blade, or their equivalents, for the purpose set forth. Lastly, I claim the construction of the cutter blades, as formed on the under side with a rasp or roughened surface, while the upper side forms a shear cutting edge, for the purpose of preventing choking of the fingers, and supplying an oil box to the cutter bar, as set forth."

29. For an *Improvement in Carriers to Grain Separators;* John Blue, Covert, N. Y.

Claim.—"I claim the arrangement of the cam blocks, or their equivalents, on the shaft, for agitating the endless apron, as set forth."

30. For an *Improvement in Violins, &c.;* Cornelius S. Cooper, City of New York.

"The nature of my invention consists in removing and taking from any of said above mentioned instruments, the original beam or bass bar, which is firmly glued into the top or sound board the full length of said bass beam or bar, and putting in another beam or bar on an improved principle, which gives greater power and more brilliancy of tone to that noble instrument; the form of my improved plan for the beam or bass bar is shown in the accompanying drawings."

Claim.—"What I claim is, the application of the spring bass beam or bar, in place of the solid beam which is taken from the violin, for the violin, tenore or viola, violoncello, double bass or violono, or any other instrument requiring a bass beam or bar for the production of tone; then the support of the ends of said spring or improved bass bar, by cutting of notches or mortices in said end blocks, as shown in the accompanying drawings, and supporting said ends of spring in any manner, by connecting them or the bearings of said spring to said end blocks to produce the desired effect; also, the separation of the bass bar or beam from the top or sound board, except the three inches as before mentioned, using any wood which will produce the desired effect."

31. For a *Machine for Turning or Cutting Irregular Forms;* Nathaniel Gear, Zanesville, Ohio.

"The nature of my invention consists in making the cutter heads, one or both guides or gauges for the setting of cutting edges of the knives therein, and also guides or gauges to the pattern of the thing to be cut. Also, in the peculiar manner of securing the cutters into the cutter heads by dovetails, thus avoiding the use of keys, wedges, screws, or any other device than the shape of the ends of the knives, and grooves into which they fit."

Claim.—"What I claim is, the combination of knives, in the manner described, with a rotary cutter head, so that said head shall serve as a guide or directrix to the form or pattern carrying the material to be dressed."

32. For *Improvements in Power Looms;* James Greenhalgh, Jr., Waterford, Mass.

Claim.—"What I claim is, 1st, Suspending each leaf of harness from two jacks, which are of similar form and length, and are geared together by toothed sectors, substantially as described, for the purpose of preserving an uniformity of motion to both ends of the harness. 2d, Attaching the knife to the levers, and applying springs to the same, in

such a way that it will move on the levers in its descent in closing the shed, sufficiently to pass the points of those hooks of the ascending portion of the harness which are in a position to be raised to make the succeeding shed; and, after passing the points of the hooks, will slip under them, substantially as described. 3d, Suspending the heddle frames or the top rails, by means of sheet or hoop iron links, which are pivoted to the jacks, and are furnished with pins to enter slots or notches in the ends of the top rails, substantially as set forth, by which a simple means of attachment and detachment is obtained."

33. For an *Improvement in Temples for Looms;* Jerome B. Greene, Worcester, Mass.

Claim.—"What I claim is, the arrangement, substantially as described, of the roller, adjustable guard, and spring, upon the axle, which is parallel with the weft, whether the said roller and guard hold the cloth between two conical faces, or by teeth on the roller."

34. For an *Improvement in the Cutting Gear of Straw Cutters;* John Jones and Alexander Lyle, Rochester, New York.

Claim.—"We do not claim the knives, heads, or flanches which form a part of the heads, separately; but what we do claim is, the combination of the knives and segments of flanches, (which are attached to and form a part of the heads,) the knives being placed on the inside of the flanches, instead of the outside, in the manner and for the purpose substantially as set forth."

35. For an *Improvement in Fastening the Teeth to Clover Hulling Cylinders;* Sam'l. Karns, Bloody Run, Pennsylvania.

Claim.—"What I claim is, the binding of the teeth to the hulling cylinder by means of the wire band, as set forth."

36. For an *Improvement in Looms;* Jonathan Knowles, Cohoes, New York.

Claim.—"What I claim is, the combination of inclined guides with the whip roll, for the purpose of graduating the tension of the warps, substantially as set forth."

37. For an *Improvement in Screens of Winnowers;* Abraham Lash and Miles Moore, Belleville, Ohio.

Claim.—"We do not claim any form of any mill or shoe; but what we do claim is, the two fluted cleansers, or their equivalents, and the combination of said cleansers, as fully set forth and described; the same may be used in any common winnowing machine."

38. For an *Improved Wire Fence;* Wm. H. Meriwether, County of Comal, Texas.

Claim.—"What I claim is, the employment of the undulating or zigzag wire for fencing, substantially as described, which, by its elasticity, increases the durability and effectiveness of the fence, as specified."

39. For an *Improvement in Grain Threshers and Separators;* Abram B. Peterson, Dexter, Michigan.

Claim.—"What I claim is, 1st, The riddle, with swinging sections, as described, in combination with the interior carrier or elevator, to separate the grain from the straw, and discharge the grain on to the riddles under the head of the carriers or elevator, with the effect of permitting the cylinder and concave to be set low down, the whole operating substantially as set forth. 2d, The running of the riddle and carrier or elevator on separate and independent pulleys, in the manner and for the purposes described. 3d, The introduction of the protecting apron between the carrier or elevator and riddle, to serve the double purpose of preventing the straw from driving through the riddle, and protecting the carrier or elevator from abrasion by the grain, as fully set forth. 4th, Hanging the riddles or the riddle and wheat board to upright standards, as described, to give the upper riddle the longest stroke."

40. For a *Keyed Finger Board for Violins;* Wm. Robertson, City of New York.

Claim.—"What I claim is, combining with the finger board of a violin or musical instrument, or like musical instrument, a supplemental keyed finger board, constructed and operating substantially as described."

41. For an *Improvement in Attaching the Shafts of Vehicles to the Axles;* Safford E. Sturtevant, Hartford, Vermont.

"The nature of my invention consists in securing the shafts of vehicles to axles by means of an eye or collar, having taper or conical ends, which fit in adjustable sockets. The eye or collar may be attached to the shaft, and the sockets to the clasps which en-

compass the axle, or the eye or collar may be attached to the clasps, and the sockets to the shafts. The ends of the eye or collar are secured firmly in the sockets by means of a bolt which passes longitudinally through the eye or collar, and also passes through the sockets. By means of a nut on the bolt, the sockets may be brought nearer together, and made to fit tightly against the ends of the eye or collar, in case of the wearing of the same.

Claim.—"What I claim is, securing the shafts of vehicles to axles by means of an eye or collar having taper or conical ends which fit in adjustable sockets; the ends of the collar being kept firmly in the sockets by means of the screw bolt; the collar and sockets being attached to the shaft and axle in either of the modes herein described."

42. For *Improvements in Operating Vibrating Propellers;* Thomas Spiller and Anthony Crowhurst, Middlesex County, England; patented in England, Feb. 3, 1853.

Claim.—"Now, we wish it to be clearly understood that we do not confine ourselves to the shape of the vanes, blades, or fins, nor to the number applied, as there may be two or more sets used, or to the part of the vessel where the same may be applied, as at the stern, in the midship, or elsewhere below the water line; neither do we confine ourselves to the arrangement, as described, for giving motion to the propeller, or for regulating or reversing the action of the same; but what we claim is, vanes, blades, or fins, of whatsoever form or wheresoever applied in a vessel for the purpose of propelling the same, when such vanes, blades, or fins, are mounted on an axle or shaft, vibrating or turning freely upon its axis, and moving vertically through the water."

43. For an *Improvement in Railroad Car Ventilator;* Geo. Spencer, Utica, N. York.

Claim.—"I do not claim the use of a 'throat' and gathering, separately, nor of a surface of water separately, nor of an enlarged air chamber, or a series of them, separately, nor the combination of any two of them; but what I claim is, the application of a single 'throat,' being the termination of a 'gathering,' or gradually contracted opening, in combination and immediate connexion with a single enlarged air chamber directly above a surface of water, for the purpose of freeing the air forced into the car, from dust and cinders, thus enabling the dust and cinders to fall upon the water by their own gravity alone, substantially as described."

44. For a *Revolving Musical Scale;* Samuel D. Tillman, Seneca Falls, New York.

Claim.—"What I claim is, the employment of a fixed disk on which the musical intervals within the octave are represented by divisions of a circle, and the letters commonly used to designate the notes of the fixed scale, in combination with one or more arms, disks, or rings, rotating around the centre of the circle of the fixed disk, on which rotating arms, disks, or rings are the true and tempered divisions of the diatonic scale, so arranged that the relations of these divisions of the diatonic scale with those on the fixed scale, may be clearly seen, when the point designating the tonic or key note on the moving scale is placed opposite any of the divisions of the fixed scale, substantially in the manner and for the purposes set forth."

45. For an *Improvement in Wagon Brakes;* Wm. D. Williams, Raleigh, N. C.

Claim.—"I do not claim a double crank, attached to the front hounds of the wagon, and connected to the brakes behind the wheels, for applying the power through the action of the horse, forward and backward; but what I do claim is, forming two swinging or rolling joints between the front axle and the front hounds, in combination with the swinging brake, arranged on top the reach and in front of the wheels, for the purpose of rendering the wagon more perfectly self-locking, or for applying the brakes simply by the aid of the horse and wagon, and disengaging them by the forward action of the former; the whole being constructed, and arranged, and operating in the manner shown and described. I also claim making the brake capable of swinging on a centre, so that it may be thrown over toward the front of the reach, when it is desired to dump the load; and again thrown to its proper place after dumping, as set forth."

46. For an *Improvement in Washing Machines;* Joel Wisner, Aurora, New York.

Claim.—"I do not claim in general the use of a horizontal circular rotary wash-board in the bottom of a wash-tub, when they are used with the ordinary radial flutings, as such has been long known; but what I do claim is, making the said wash-board of a conical form, having its surface higher above the bottom of the tub at the circumference than at the centre, and attaching to it and to the bottom of the tub radial ribs of the form of a half cone, when these ribs are formed of such depth, and with spaces so wide between them, as to receive the clothes in those spaces in such manner as to turn or roll them over as the board is rotated back and forth, as described."

47. For *Improvements in Window Shutter Bolts;* Samuel Green, Assignor to Samuel Green and Cornelius Arnett, Salem, N. J.

Claim.—"What I claim is, the spring and drop bolt or tumbler, arranged with reference to each other, and the notch in the case, as described, and so formed and located that they may be acted upon in the manner described by a single key."

48. For an *Improvement in Manufacturing Ice;* Alexander C. Twining, Hudson, Ohio; patented in England, July 3, 1850.

Claim.—"I do not claim the exhaustion of a vessel containing ether and immersed in water, around which the water freezes, and to which the ether is returned after condensation in the restorer; but what I claim is, 1st, The combination of an exhausting pump or apparatus that is also condensing or compressing with a restorer and with a freezing cistern having water chambers, substantially as above. 2d, I claim the same pump and restorer in combination with a separate exhaust vessel, (the same whose connexion is indicated in the drawing,) by, in, or around which the ether or other liquid uncongealable at the temperature employed is cooled, and made to pass into the freezing cistern, and there perform its office, substantially as above. 3d, I claim the percolator, or apparatus, introducing into the cistern or the separate exhaust vessel, the ether or volatile liquid in jets or drops, as above, in combination with the exhaust pump and restorer. 4th, I claim the use of the water vessels in combination with the water chambers and the intervening liquid, for perfecting contact, as set forth. Finally, I claim, in combination with the restoring apparatus, the cooling of the liquid around the same, by exhaustion, using therefor the secondary pump and connexions, substantially as set forth."

MECHANICS, PHYSICS, AND CHEMISTRY.

A New Mode of Conducting the Daguerreotype Process. By W. H. Stanley Crawford.*

In the course of numerous experiments in the daguerreotype art, I found that after plates were prepared in the usual way with the vapors of iodine and bromine, ready for being impressed in the camera, there was a constant evaporation from their surfaces, to a greater or less extent; and this fact was most marked when I had prepared plates for views, &c., but which could not be used till several hours afterwards; in the latter case, the bromine, more volatile than the iodine, had evaporated more rapidly, and consequently the proportions between the two, so necessary for a good picture, were entirely destroyed. Another circumstance that struck me was, that if a plate were prepared well, and allowed to remain in the dark box *a few minutes* ere placing it in the camera, the resulting impression was always more sharply and better defined than if the plate had been immediately used; in the latter case, the impression being not unfrequently somewhat clouded in detail. These observations led me to the conclusion, that when under the ordinary process a plate was exposed in the camera, and the actinic rays allowed to act on its sensitive surface, the evaporation (above alluded to) being let loose in the camera, the vapors again attacked those portions of the surface affected by the actinic agency, and so prolonged the operation; for it is well known that the mixed vapors, so long as they exist, will, if allowed to fall on the plate, altogether, neutralize the effect of the actinic power. I hereupon set about thinking of some plan to remedy the defect, and eventually determined to allow

* From the London Journal of the Photographic Society, No. 9.

the plate to be acted upon *simultaneously* by the *actinic ray* and the *vapor of mercury* or *light transmitted by means of a yellow medium*, and the result *quite bore out* my expectation.

Having no apparatus adapted for carrying out my views neatly, I was put to make shift the best way I could, and I did thus: An ordinary camera was placed before the object to be taken, the focus nicely adjusted, and, immediately before inserting the dark box with the prepared plate, a thick cast iron cup, filled with mercury, was heated to the usual degree, and placed inside the camera; the slide of the dark box was then withdrawn, and the plate exposed by uncovering the lens. Pictures, by these means, were taken in a fraction of a second, giving a gain in time say in the ratio of one to five seconds over the ordinary way; the details were most sharply and beautifully delineated, and the pictures very firmly set on the plate, so much so, as to give much trouble to clean, even before being subjected to the fixing process. It will of course be understood, that, although the picture was taken in a fraction of a second, the plate had to remain at least five minutes afterwards in the camera, the point gained being simply that the parts affected by the actinic influence were immediately acted upon by the vapor of mercury, and thereby prevented from reabsorbing any of the loose vapors, and thus the resulting picture was not only expedited, but much improved.

I have now constructed a camera which simplifies the operation much, and which for a traveling daguerreotypist is a great improvement, as it does away with the necessity of a mercury box, and saves all the time and trouble of changing the plate from one box to another, pouring and repouring the mercury, &c. It is formed thus: A, fig. 1, is the usual

Fig. 1.

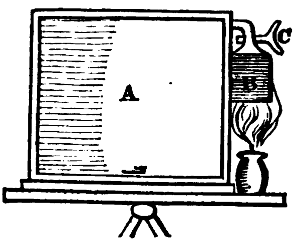
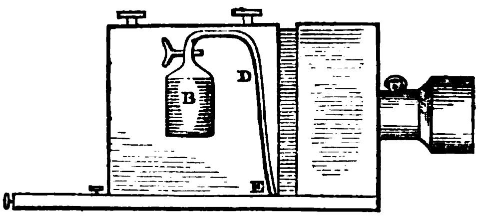


Fig. 2.



form of camera, showing a back view. B is a cast iron bottle of the capacity (for mercury) of say 3 or 4 ounces, and screwed in a convenient place, on about the centre of the hinder or sliding part of the camera; and C is a close fitting cock, to shut off or allow to escape the mercurial fumes when heated. Fig. 2, D, is a pipe, say of metal, bent from the upper part close to the side of the camera, and leading inside by a close fitting aperture, E. The working must now be obvious; the bottle, B, is placed rather well up on the side of the camera, to allow of its being conveniently heated with a spirit-lamp.

I have found the same results effected by admitting *light* into the camera through a yellow medium; but as this can only be done in *a strong light*, it would not be of such general use as the preceding plan.

I may mention here, that I am one of those who hold that it is the *color of the vapor* (yellow) of mercury which developes the latent picture on the plate, and not particles of mercury attaching themselves to the silver, as some affirm. The sun's rays, through a yellow or orange medium, act precisely in the same manner; but I cannot now enter upon my reasons, as it would occupy too much space and too much of your valuable time. With regard to the process that I have now communicated, it may be suggested that the mercurial vapor would injure, or, at all events, not improve the back lens, upon which, of course, it must of necessity fall in cameras constructed upon the present plan, though hitherto I have not found my lens affected at all; but to obviate any risk of such damage, the camera should have an air-tight partition of clear blue glass immediately in rear of the lens.

On the Determination of the Ammonia Contained in Waters. By M. Boussingault.*

Boussingault refers to the necessity of determining the quantities of ammonia contained in well water, river water, &c. Since the time (1802) when De Saussure ascertained the first traces of ammonia in the air, since Brandes (1825) discovered it in rain water, and especially since the time when Liebig distinctly proved this occurrence of ammonia, no complete investigations into the quantity of ammonia contained in natural waters has yet been made.

Boussingault has now begun to determine the ammonia in such waters by means of a distillatory apparatus. He regards it as certain that a water charged with a small quantity of ammonia will have given off the whole of this with the watery vapor when two-fifths of the water have distilled over.

We may, consequently, by submitting large quantities of water, as 10 litres or more, to a preliminary distillation, obtain a concentrated fluid, so as to treat this in the still set apart for the determination of the ammonia. Where the water is not too poor in ammonia, it may be placed in the apparatus itself.

The apparatus consists of a retort capable of containing 2–3 litres. A litre of the water to be examined is put into this, if necessary previously concentrated. The cooling of the distillate is effected by means of a glass worm tube. One-fifth is distilled off, and the quantity of ammonia contained in it ascertained, according to Peligot's method of determination of nitrogen by means of a solution of sulphuric acid of known strength. A second fifth is then distilled. In this there is generally no more ammonia, and the quantity found in the first portion is usually correct.

The normal solution of sulphuric acid for the determination of the ammonia is so composed that 5 cub. centims. of this fluid shall be saturated by 0·0106 of ammonia. As the alkaline fluid which serves for the testing of the solution is so far diluted that 33 cub. centims. of it saturate the 5 cub. centims. of dilute acid, 1 cub. centim. of the alkaline fluid

* From the London Chemical Gazette, No. 260.

represents 0·00032 of ammonia; and as the burette is divided into tenths of a cubic centimetre, one division represents 0·000032 of ammonia.

As regards the accuracy of the determination, it is necessary in this process to take care that the normal acid is first added to the fluid to be tested for ammonia, and that the alkaline fluid intended for the saturation of the acid is then poured in. Any inaccuracy must therefore arise from an error of two divisions of the burette. The determination of the ammonia can therefore only be brought within 0·06 milligrm.; but as the operation can always be performed twice, even if the errors of the two experiments do not compensate one another, the error of the method cannot exceed a tenth of a milligramme.

The author then instituted experiments to test this method. From these it appeared that distilled water to which a known quantity of ammonia had been added furnished more ammonia than had been mixed with it; so that, apparently, all distilled water contains ammonia. The water employed in the following experiments was distilled first with sulphate of alumina, and afterwards over potash, to remove any ammonia and carbonic acid that might be contained in it. In the following table the first column gives the number of the experiment, the second the quantity of ammonia added to the water, the third the quantity obtained from the distillate, and the fourth the difference between the two preceding:—

I.	II.	III.	IV.
1.	0·01233	0·01224	—0·00009
2.	0·00036	0·00037	+0·00001
3.	0·01056	0·01040	—0·00016
4.	0·01130	0·01131	+0·00001
5.	0·00836	0·00840	+0·00004
6.	0·04944	0·04950	+0·00006
7.	0·00413	0·00410	—0·00003

The following is a table of the quantities of ammonia ascertained by the author in various waters:—

Month.		Ammonia in 1 litre. of water. grm.	Ammonia in 1 cub. m. of water. grm.
April.	Water from the Seine (*au pont d'Austerlitz*,)	0·00012	0·12
April.	Water from the Seine (*au pont de la Concorde*,)	0·00016	0·16
April.	Water from Ourcq (*fontaine du Conservatoire*,)	0·00073	0·73
May.	Water from Ourcq (*fontaine du Conservatoire*,)	0·00003	0·03
Mar.	Water from the Canal de Loing (*d'Montargis*,)	0·00032	0·32
April.	Water of the Bieber (*au Pont-aux-Tripes*,)	0·00261	2·61
April.	Water of the Arcueil, ...	0·00017	0·17
April.	Water from a well near Andilly (*Montmorency*,)	0·00003	0·03
May.	Water from the Lac d'Enghien, . . .	0·00007	0·07
April.	Water of a well near Guermantes (*Lagny*,)	0·00000	0·00

With the exception of the Bieber, which is rather an outlet for the numerous industrial establishments than a river, all the above waters contain less ammonia than rain water; the well near Lagny (*Seine-et-Marne*) contained none at all, or none that could be ascertained.

In the rain water collected on the terrace of the Observatory at Paris, Barral found on an average 3·35 milligrms. of ammonia to 1 litre of water. The greatest quantity that he met with was 5·45 milligrms. Boussingault

has hitherto made but few determinations of the ammonia in rain water, but these agree well with Barral's. Thus in the first week of April he found 4·34 milligrms. in 1 litre of rain water at Paris. This is twenty-seven times as much as existed at the same time in the Seine water. On the 7th of May the rain water contained 0·0032 grm. in 1 litre.

The water of the Lac d'Enghien, according to the above table, contains a tenth of a milligramme of ammonia in 1 litre. A spring which rises near this lake contains 5·06 milligrams. Considered as bicarbonate of ammonia, this gives 0·0181 of the salt; it is possible that this assists the medicinal action of the sulphurous water of Enghien.

In 1 litre of sea water from near Dieppe the author found 0·00020 grm. of ammonia. If we consider that two-thirds of the surface of the globe are covered with water, the sea always contains a considerable quantity of ammonia, which may return again into the atmosphere.

In places where great numbers of people live, the quantity of ammonia in the soil must increase. The investigation of the following spring waters proves this:—

	In 1 litre. grm.	In 1 cub. metre. grm.
Spring in a garden (*Jardin de Clignancourt*) outside Paris,	0·00032	0·32
Spring of a house in the *Rue du Parc-Royal*, .	0·00132	1·32
Spring of a house in the *Place de l'Hotel-de-Ville*, .	0·03435	34·35
Spring of a house *Quai de la Mégisserie*, No. 30, .	0·03033	30·33
Spring of a house *Quai de la Mégisserie*, No. 28, .	0·03386	33·86
Spring of a house in the *Rue de la Tabletterie*, .	0·00026	0·26

The Parisian well water is not drinkable. It is very hard, decomposes soap, and is not fit for boiling vegetables. It has in general no smell; the great quantity of ammonia contained in this water may nevertheless arise from dung or other decaying organic matters.

The author collected some snow in March, immediately after its falling on a terrace, and thirty-six hours afterwards some from the fertile earth of a garden. On determining the ammonia contained in the water resulting from the melting of the snow, he found in the

	In 1 litre.	In 1 cub. metre.
Snow from the terrace, . .	0·00178	1·78
Snow from the garden, .	0·01034	10·34

The large quantity of ammonia in the snow from the garden must apparently have passed into it from the soil.—*Comptes Rendus*, vol. xxxvi. p. 814.

For the Journal of the Franklin Institute.

Steam Logs of the Pacific, Collins Steamer, plying between New York and Liverpool. By B. F. Isherwood, Chief Eng., U. S. N.

The four steamers composing the Collins line, viz: the *Pacific*, *Atlantic*, *Baltic*, and *Arctic*, have all about the same linear dimensions and displacements, though they are not modeled precisely alike; for instance, the bow of the *Atlantic* is sharper than the bow of the *Pacific*, but the stern of the *Pacific* is finer than the stern of the *Atlantic*. The engines of

the first two are alike, and those of the last two only differ from them in length of stroke of piston, the former having nine feet, and the latter ten feet stroke. The boilers of all four vessels are of the same type and general arrangements, but differ considerably in their proportions; the boilers of the *Pacific* and *Atlantic* are alike; those of the *Baltic* and *Arctic* are alike also, but are larger than those of the former vessels, with a view to supply a proportionally increased amount of steam for their greater capacity of cylinder.

To the kindness of Engineer-in-Chief D. B. Martin, U. S. N., who was for some time Chief Engineer of the *Pacific*, I am indebted for the steam logs of that vessel for the voyages made by him, and for an accurate drawing of the boiler, taken from actual measurement; also, for a large number of indicator diagrams, showing the exact quantity of steam used, &c. Believing this information to have considerable practical value, I have arranged it for the *Journal*, and added the dimensions of the hull and machinery of the vessel. In a previous number of the *Journal*, and by the kindness of the same gentleman, I gave similar information regarding the *Arctic*, and as the *Atlantic* and *Baltic* are nearly duplicates of the *Pacific* and *Arctic*, the present information covers with sufficient exactness the performance of all the vessels of this celebrated line.

HULL.

Length extreme,	290 feet.
" on deck,	282 "
" between perpendiculars,	280 "
" on keel,	271 "
Beam on deck, extreme,	45 " 6 in.
Depth of hold to spar deck,	32 "
" " main deck,	24 "
Burthen by custom-house measurement,	2775 tons.
Mean draft of water with half coal in and other weights full,	19 feet.
Immersed amidship section, at 19 feet draft,	685 sq. feet.
Displacement at 19 feet draft,	3724 tons.
" per inch of draft at 19 feet draft,	22 "

ENGINES.—Two side lever, condensing engines, with balance-puppet valves and a fixed cut-off, cutting off at four feet from the commencement of the stroke.

Diameter of cylinders,	95 inches.
Stroke of pistons,	9 feet.
Space displacement of both pistons per stroke,	886.032 cubic ft.
Steam space between cut-off valves and pistons at one end of both cylinders,	25 "

PADDLE WHEELS—Of the common or radial kind.

Diameter from outside to outside of paddles,	35 ft. 6 in.
Length of each paddle,	10 " 6 "
Width of each paddle,	21½ inches.
Immersion of lower edge of paddle at 19 feet draft of vessel,	7 feet.
Number of paddles in one wheel,	28.
" " water in one wheel at 19 feet draft of vessel,	7.
Area of two paddles,	37.625 sq. feet.
" all immersed paddle surface at 19 feet draft of vessel,	263.375 " "
Proportion of area of two paddles to area of immersed amidship section of hull at 19 feet draft,	1·000 to 18·206
Proportion of area of all immersed paddle surface to area of immersed amidship section of hull at 19 feet draft,	1·000 to 2·601

BOILERS.—Four iron boilers with vertical tubes. The water is con-

tained within and the fire is applied without the tubes. The boilers are placed in pairs, back to back, with one chimney in common. The forward and after pair are alike, except in breadth, breadth of furnace, and number of tubes; each forward pair being 12 feet 10 inches broad, with furnaces 30 inches broad, and containing 1184 tubes; and each after boiler being 14 feet broad, with furnaces 33½ inches broad, and containing 1332 tubes; making 5032 tubes in the four boilers. The tubes are of iron, and 2 inches in external diameter; 2516 are 5 feet long, and 2516 are 4 feet 6 inches long. Distance between centres of tubes lengthways the boiler, 2·944 inches; crossways the boiler, 3·5625 inches. Opposite each double furnace of the after pair of boilers, there are nine rows of tubes—of the forward pair, eight rows—in each row of both pairs there are 37 tubes.

Length of each boiler, (exclusive of connexions,) .		21 feet 5 inches.
Height of each boiler, (exclusive of steam chimney,) .		13 " 8 "
Breadth of each forward boiler, . .		12 " 10 "
" " after boiler, . .		14 "
Number of furnaces in each boiler, . .		8
Heating surface in furnaces of the two forward boilers,	1864·0 sq. ft.	
" " tube boxes of " " "	944·0 "	
" " back connexion " " "	697·4 "	
" " tubes of " " "	5889·3 "	
Total heating surface " " "		9394·7 sq. ft.
Heating surface in the furnaces of two after boilers,	2000·0 "	
" " tube boxes " " "	974·0 "	
" " back connexions " "	733·0 "	
" " tubes " " "	6625·4 "	
Total heating surface " " "		10332·4 "
Total heating surface in the four boilers, . .		19727·1 "
Grate surface in the two forward boilers, . .		230·00 sq. ft.
" " " after " . .		256·83 "
Total grate surface in the four boilers, . .		486·83 "
Aggregate cross area between tubes in two forward boilers,	44·333 sq. ft.	
" " " " after "	49·083 "	
Total in the four boilers,		93·416 "
Total " " of the spaces between the line produced of the bottom of the tubes and hanging bridge at the back of the four boilers, ...		63·500 "
Cross area of the smoke chimney, . .		78·54 "
Height of the smoke chimney above the grates, .		75 feet.
Capacity of steam room in the four boilers, . .		3630 cub. ft.
Weight of sea water contained in the four boilers, (calculated,)		244,400 lbs.

PROPORTIONS.

Proportion of heating to grate surface, . .	40·521 to 1·000
" " grate surface to aggregate cross area between tubes,	5·211 "
" " " " " the line produced of the bottom of the tubes and hanging bridges at back of boilers, . .	7·667 "
" " grate surface to cross area of the smoke chimney,	6·198 "

Fifth Voyage from New York to Liverpool.

DATE. 1851.	Average steam pressure in boiler per sq. in. above atmos. in pounds.	Average number of double strokes of piston made per minute.	Total number of double strokes of piston made.	Time—Hours and minutes.	Coal consumed in tons of 2240 lbs.	Geographical miles run by observation.	Latitude.	Longitude.	REMARKS.
Jan. 23	13·3	12·24	17320	23 35	80	255	41° 16′	68° 26′	During this voyage, Cumberland bituminous coal was burned, but it furnished steam in such insufficient quantities that the engines were compelled to be run with the throttle only ¼ open.
" 24	13·0	12·61	17845	23 35	58	287	42 59	62 22	
" 25	14·7	13·44	19015	23 35	64	285	45 21	58 07	
" 26	12·6	12·60	17775	23 30	58	285	46 12	50 57	
" 27	11·8	11·43	16105	23 29	50	161	46 56	47 22	
" 28	14·4	13·80	19352	23 22	60	290	47 58	39 58	
" 29	9·6	12·30	17475	23 41	51	259	48 36	33 36	
" 30	9·5	12·02	17025	23 37	52	270	49 00	27 38	For the greater part of the voyage there was a gale on the port quarter.
" 31	10·2	12·19	17235	23 33	54	261	49 34	19 59	
Feb. 1	10·2	11·34	16057	23 36	58	237	49 55	13 29	
" 2	11·5	13·37	18853	23 30	65	278			
" 3	11·5	12·90	18283	23 30	60	270			
Totals,			212340	282 33	710	3138			
Means,	11·9	12·525			5629lb. per h'r.	11·106 per h'r.			

Fifth Voyage from Liverpool to New York.

Feb. 23	13·6	10·90	13785	21 04	65	482 (Feb. 23–24)			
" 24	15·0	11·46	16725	24 19	66				
" 25	15·2	11·93	17835	24 55	65	273	48° 34′	28° 05′	
" 26	15·4	11·94	17490	24 25	66	273			
" 27	15·0	11·76	17225	24 25	67	256	47 09	34 21	
" 28	15·2	11·82	17270	24 21	62	248	46 14	38 50	
Mar. 1	15·4	13·46	19751	24 27	68	300	44 06	45 30	Weather not noted on this voyage.
" 2	15·8	12·19	17859	24 25	63	238	42 56	50 00	
" 3	15·0	14·23	20868	24 27	72	311	42 42	57 28	
" 4	13·0	11·24	16408	24 20	56	214	42 49	62 18	
" 5	14·3	13·70	20004	24 20	67	266	41 24	67 16	
" 6	15·0	14·63	21250	24 12	72	283			
" 7	16·0	13·76	4350	5 16	15	58			
Totals,			220820	294 56	774	3205			
Means,	14·9	12·480			6035lb. per h'r.	10·857 per h'r.			

Sixth Voyage from New York to Liverpool.

DATE. 1851.	Av. steam pres. in boil. per sq. in. above atmos. in pounds.	Average number of double strokes of piston made per minute.	Total number of double strokes of piston made per minute.	Time—Hours and minutes.	Coal consumed in tons of 2240 pounds.	Geographical miles run by observation.	Latitude.	Longitude.	REMARKS.
Mar. 20	16·9	13·04	18415	23 32	63	256	40° 38′	68° 26′	During this voyage, Cumberland bituminous coal was burned, but it furnished steam in such insufficient quantities that the engines were compelled to be run with the throttles partly closed.
" 21	15·2	12·75	18025	23 34	68	286	41 11	62 06	
" 22	15·6	12·79	17940	23 23	70	275	41 14	56 00	
" 23	15·7	13·34	18784	23 28	74	290	42 10	49 07	
" 24	15·3	13·00	18306	23 28	72	275	43 01	43 01	
" 25	15·0	13·05	18370	23 27	74	284	45 17	36 25	
" 26	13·2	13·43	18970	23 32	77	299	47 34	30 09	
" 27	13·0	13·32	18784	23 30	73	276	49 32	24 33	Weather not noted on this voyage.
" 28	14·0	13·84	19425	23 21	74	280	51 03	17 38	
" 29	13·8	13·78	19315	23 22	76	290	Cape	Clear.	
" 30	14·4	15·42	22212	24 00	76	333			
Totals,			208546	258 37	797	3144			
Means,	14·7	13·440			7280lb. per h'r.	12·157 per h'r.			

Sixth Voyage from Liverpool to New York.

DATE.	Av. steam pres.	Av. strokes	Total strokes	Time	Coal	Miles	Latitude	Longitude	Remarks
Ap. 10	16·9	14·78	18301	22 18	65	272			
" 11	17·2	14·09	20692	24 28	63	308	50° 54′	17° 21′	
" 12	17·2	14·07	20820	24 40	66	310	49 29	25 23	
" 13	16·8	14·23	21090	24 42	71	306	48 15	32 48	Fine weather, and vessel under all sail during the whole voyage.
" 14	17·1	14·70	21615	24 30	69	328	46 29	40 14	
" 15	17·0	14·87	21845	24 29	75	318	44 57	48 02	
" 16	17·0	15·35	22480	24 25	73	316	43 46	55 04	
" 17	14·2	14·30	20925	24 23	69	300	42 39	61 42	
" 18	15·0	15·00	22020	24 29	70	302			
" 19	16·0	16·46	21722	22 00	75	296			
Totals,			211510	240 24	696	3056			
Means,	16·4	14·664			6485lb. per h'r.	12·712 per h'r.			

Seventh Voyage from New York to Liverpool.

DATE. 1851.	Average steam pressure in boilers per sq. inch above atmos. in lbs.	Average number of double strokes of piston made per minute.	Total number of double strokes of piston made.	Time—Hours and minutes.	Coal consumed in tons of 2240 pounds.	Geographical miles run by observation.	Latitude.	Longitude.	REMARKS.
May 11	16·4	13·48	19012	23 30	62	300			
" 12	17·4	14·39	20285	23 29	67	312	42° 53′	61° 22′	During this voyage, a superior lot of picked Pennsylvania anthracite was burned.
" 13	17·6	15·00	21180	23 33	73	302	45 02	55 00	
" 14	17·0	15·22	21480	23 31	74	305	46 30	48 05	
" 15	16·0	14·52	20508	23 32	74	293	47 38	41 25	
" 16	15·0	14·44	20372	23 31	78	299	48 32	34 40	
" 17	16·6	15·57	22002	23 33	75	306	49 28	27 29	
" 18	15·7	16·35	22810	23 15	76	320	51 12	18 50	Weather not noted on this voyage.
" 19	15·0	15·75	22048	23 20	79	314	51 31	10 32	
" 20	16·3	17·28	24880	24 00	80	327	Channel.		
Totals,			214577	235 14	738	3078			
Means,	16·3	15·203			7028lb. per h'r.	13·085 per h'r.			

Seventh Voyage from Liverpool to New York.

DATE. 1851.	Average steam pressure in boilers per sq. inch above atmos. in lbs.	Average number of double strokes of piston made per minute.	Total number of double strokes of piston made.	Time—Hours and minutes.	Coal consumed in tons of 2240 pounds.	Geographical miles run by observation.	Latitude.	Longitude.	REMARKS.
May 29	16·5	12·14	19310	26 30	64	314	55° 19′	10° 20′	
" 30	16·0	13·32	19575	24 30	69	282	54 24	18 11	Heavy head sea.
" 31	16·7	14·17	20828	24 30	69	312	53 17	26 48	Light head wind.
June 1	16·0	14·49	21297	24 30	79½	308	51 47	34 40	" "
" 2	16·3	14·60	21465	24 30	81½	301	49 54	41 20	" "
" 3	16·0	15·54	22844	24 30	77	318	48 31	49 00	Beam wind and sea.
" 4	15·6	14·39	21150	24 30	82	290	46 11	55 13	H'vy head wind & sea.
" 5	16·6	15·65	23000	24 30	88	312	44 21	62 04	" " "
" 6	16·7	16·70	24555	24 30	86	324	41 50	68 36	Light head wind & sea.
" 7	15·7	17·28	25125	24 14	90	332			" " "
Totals,			219149	246 44	786	3093			
Means,	16·2	14·480			7136lb. per h'r.	12·536 per h'r.			

Eighth Voyage from New York to Liverpool.

DATE. 1851.	Average steam pressure in boilers per sq. inch above atmos. in lbs.	Average number of double strokes of piston made per minute.	Total number of double strokes of piston made.	Time—Hours and minutes.	Coal consumed in tons of 2240 lbs.	Geographical miles run by observation.	Latitude.	Longitude.	REMARKS.
June 22	17·0	13·43	18824	23 22	68	286	40° 54′	68° 07′	Light w'd & sm'th sea.
" 23	17·8	13·62	19135	23 25	72	292	43 36	62 36	Light h'd w'd & mod "
" 24	18·0	14·21	20210	23 42	74	296	46 00	56 58	" " "
" 25	17·3	14·70	20848	23 39	76	298	47 15	50 00	" " "
" 26	17·8	15·17	21387	23 30	79	297	48 39	42 54	" " "
" 27	17·3	15·47	21885	23 35	82	304	49 50	35 22	" " "
" 28	17·1	15·15	21360	23 30	86	288	50 36	27 59	Fresh h'd w'd & hvy "
" 29	16·7	15·63	22100	23 34	92	297	51 25	20 16	Mod h'd w'd & mod "
" 30	17·0	16·31	23150	23 39	89	308	51 23	12 07	Light h'd w'd & smth"
July 1	16·5	16·79	23150	23 00	89	328	Chan-	Holy-	" " "
" 2	not noted.	17·84	7005	6 44	35	160	nel.	head.	
Totals,			219054	241 30	842	3094			
Means,	17·3	15·118			7810lb. per h'r.	12·812 per h'r.			

Eighth Voyage from Liverpool to New York.

July 10	18·0	12·75	15116	19 46	60	225	Balacotton.		
" 11	18·0	13·07	19229	24 31	68	286	51° 27′	15° 34′	Fresh br. ahd, mod sea
" 12	17·9	13·27	19495	24 30	70	280	51 23	23 01	Strong " " hvy "
" 13	16·3	11·03	16162	24 25	59	208	51 16	28 35	Hvy gale " " "
" 14	17·0	13·27	19500	24 30	71	282	50 28	35 28	Strong w'd " " "
" 15	17·0	14·27	20995	24 32	81	311	49 39	43 20	Mod. wind " mod. "
" 16	17·5	14·67	21511	24 26	86	294	48 53	50 43	" " "
" 17	17·0	14·10	7614	9 00	31	122	45 38	54 50	Strong w'd " " "
Means, *	17·3	13·247			6707lb. per h'r.	11·431 per h'r.			

Performance with Starboard Engine alone, after the breaking down of the other, cutting off the Steam at seven-ninths the Stroke.

July 17	11·0	9·00	8280	15 20	30	132	45° 38′	54° 50′	Strong wd. a'd, m'd sea
" 18	13·7	10·34	15068	24 18	47	210	44 37	59 34	Mod. h'd. w'd. and sea
" 19	14·2	10·60	15503	24 23	45	195	43 56	63 58	" " "
" 20	13·9	10·90	15880	24 16	43	200	41 28	67 13	" " "
" 21	14·0	10·73	15677	24 21	43	227	40 40	72 00	" " "
" 22	14·0	11·92	6676	9 20	20	97			
Means, †	13·5	10·533			4187lb. per h'r.	8·863 per h'r.			

* Before port engine broke.
† After port engine broke.

Ninth Voyage from New York to Liverpool.

DATE. 1851.	Average steam pressure in boilers per sq. inch above atmos. in lbs.	Average number of double strokes of piston made per minute.	Total number of double strokes of piston made.	Time—Hours and minutes.	Coal consumed in tons of 2240 lbs.	Geographical miles run by observation.	Latitude.	Longitude.	REMARKS.
Aug 17	16·0	12·81	14855	19 20	65	245	43° 48′	69° 11′	This day lost 4¼ hs. by run'g into a brig.
" 18	17·6	13·52	17545	21 38	74	269	42 58	64 00	This day stop'd 1¾ hs. Light brez ah'd.
" 19	17·3	13·94	19612	23 27	76	294	45 48	58 56	Light fair wd. mod sea
" 20	16·8	14·02	19913	23 40	83	302	45 56	52 04	" " "
" 21	16·5	14·02	19854	23 35	80	311	48 22	44 38	Mod. " "
" 22	17·2	14·34	20188	23 28	83	311	49 54	37 05	" " "
" 23	17·0	15·41	21668	23 26	84	310	50 52	29 05	Mod b'm wd., mod sea.
" 24	17·0	15·36	21664	23 30	81	310	51 35	21 19	" .. " "
" 25	17·2	15·92	22446	23 30	84	308	51 20	13 10	" " h'vy "
" 26	15·7	16·11	22780	23 34	81	312	Channel.		Mod gale abm, h'vy "
" 27	16·6	15·85	8762	8 40	4	120	Liverpool.		
Totals,			209278	238 08	795	3072			
Means,	16·8	14·647			7478lb. per h'r.	12·294 per h'r.			

Ninth Voyage from Liverpool to New York.

DATE. 1851.	Average steam pressure in boilers per sq. inch above atmos. in lbs.	Average number of double strokes of piston made per minute.	Total number of double strokes of piston made.	Time—Hours and minutes.	Coal consumed in tons of 2240 lbs.	Geographical miles run by observation.	Latitude.	Longitude.	REMARKS.
Sept. 4	17·4	13·0	17731	22 21	65	265	Channel.		Light h'd wd smth se
" 5	17·6	13·75	20269	24 34	78	310	52° 01′	17° 19′	Mod. fair w'd., mod. "
" 6	17·3	13·81	20264	24 27	81	312	51 36	25 40	" " "
" 7	17·1	13·41	19705	24 29	82	265	51 19	32 41	Mod gale ahd., h'vy "
" 8	17·4	13·63	20093	24 34	84	270	50 41	39 15	" " "
" 9	16·3	12·06	17632	24 22	62	222	49 45	44 50	Hvy gale ah'd, h'vy "
" 10	17·0	14·79	21705	24 28	87	291	47 36	51 23	Light h'd w'd, mod. "
" 11	16·6	16·15	23712	24 28	84	326	45 19	58 35	" " sm'th "
" 12	16·7	16·03	23533	24 28	81	318	42 22	64 39	Mod. h'd. w'd., mod. "
" 13	17·0	16·51	24100	24 20	84	312	40 50	71 15	" " "
" 14	14·5	18·67	13720	12 15	55	178	New York.		" " "
Totals,			222464	254 46	843	3069			
Means,	16·9	14·553			7412lb. per h'r.	12·047 per h'r.			

Summary of the Steam Logs.—From New York to Liverpool.

Voyage.	DATE.	TOTALS. Total number of double strokes of piston made.	Total time from dock to dock—Hours and minutes.	Total coal consumed in tons of 2240 pounds.	Total geographical miles run by observation.	MEANS. Mean Steam pressure in boilers per sq. in. above atmosphere in pounds.	Mean number of double strokes of piston made per minute.	Mean number of pounds of coal consumed per hour.	Mean speed of the vessel per hour in geo. miles of 6082⅔ feet,
	Burning Cumberland Bituminous Coal.								
5th.	J'n. & F'b. '51.	212340	282 33	710	3138	11·9	12·525	5629	11·106
6th.	March, "	208546	258 37	797	3144	14·7	13·440	7280	12·157
	Means,	210443	270 35	753½	3141	13·2	12·962	6418	11·608
	Burning Pennsylvania Anthracite.								
7th.	May, '51.	214577	235 14	738	3078	16 3	15·203	7028	13·085
8th.	June & July "	219054	241 30	842	3094	17·3	15·118	7810	12·812
9th.	August, "	209278	238 08	795	3092	16·8	14·647	7478	12·294
	Means,	214303	238 17	791⅔	3088	16·8	14·988	7442	12·729

Burning Welsh Anthracite.

5th.	F'b. & Mar. '51	220820	294 56	794	3205	14·9	12·480	6035	10·857
6th.	April, "	211510	240 24	696	3056	16·4	14·664	6485	12·712
7th.	May & June, "	219149	246 44	786	3093	16·2	14·480	7136	12·536
8th.	July, "	216706	—	—	3069	—	—	—	—
9th.	September, "	222464	254 46	843	3069	16·9	14·553	7412	12·047
	Means,	218130	259 12	779¾	$3098\frac{4}{10}$	16·0	13·972	6745	11·979

From the above summary, if we omit the steam and fuel items of the fifth and sixth voyages from New York to Liverpool, in which the kind of fuel used did furnish sufficient steam to work the engines with wide throttles, it appears that the mean distance run in crossing is 3104 geographical miles. The distance by Mercator is 3084, and by Mercator and great circle 3023 geographical miles; there was consequently an increase of 81 miles above the shortest distance, or 2·68 per centum of that distance. The mean number of revolutions of the wheels required to make the passage from New York to Liverpool is 212,759; to make the passage from Liverpool to New York, 218,130, or 2·52 per centum of the former more. The mean consumption of anthracite coal per voyage is 785 tons of 2240 pounds. The mean pressure of steam carried in the boilers per square inch above the atmosphere is 16 pounds. The mean speed of the vessel in the voyages from New York to Liverpool is 12·729 geographical miles per hour; in the voyages from Liverpool to New York, 11·979 miles per hour, or a less speed by 6·26 per centum of the latter. The mean number of revolutions of the wheels made per minute during the voyages from New York to Liverpool is 14·988; in the voyages from Liverpool to New York, 13·972, or 7·27 per centum of the latter.

In the following Table of Results, the cylinder pressures are as given by the indicator; and in the calculation of the evaporation by the fuel, there is included the loss by *blowing off* sufficient quantities of water to maintain it at one and three-quarters the natural concentration; also, the steam required to fill the nozzles and clearance of the cylinder. The temperature of the feed water was carried at 110° F. The latent heat of steam is taken from Regnault's experiments.

The loss of effect by the oblique action of the paddle is calculated as the squares of the series of their angles of incidence on the water.

Table of the Results from the Performance of the Pacific.

	From New York to Liverpool.		From Liverpool to New York, burning Welsh anthracite.
	Burning Cumberland bituminous coal.	Burning Pennsylvania anthracite.	
OBSERVED.			
Speed of vessel per hour in geographical miles of 6082⅔ feet,	11·608	12·729	11·979
Revolutions of the wheels per minute,	12·962	14·988	13·972
Steam pressure in boilers above atmosphere in pounds per square inch,	13·2	16·8	16·0
Steam pressure (initial) in cylinders above atmosphere in pounds per square inch,	9·2	14·1	13·3
Pounds of coal consumed per hour,	6418·	7442·	6745·
Tons of coal consumed per 24 hours,	68·764	79·736	72·268
CALCULATED.			
Mean effective pressure on pistons in pounds per square inch,	14·49	18·32	17·70
Horse power developed by the engines,	1450·65	2122·01	1912·33
Slip of the centre of pressure of the paddle in per centums of its speed,	15·62	19·98	19·22
Oblique action of the paddles,	21·63	21·63	21·63
Pounds of steam evaporated per hour, from sea water of 1¾ the natural concentration, with temperature of feed water 110° F., by 1 pound of coal; including loss by *blowing off* to maintain the water at that concentration, and loss by waste steam in nozzles and clearances of cylinders,	7·070	8·445	8·494
Pounds of coal consumed per hour per square foot of grate furnace,	13·183	15·287	13·855

From the above table, it will be perceived that the boilers had a very high evaporative efficiency, probably as high as can be practically obtained. It also shows that the evaporative power of equal weights of Pennsylvania and Welsh anthracites was sensibly the same, and greatly higher than the result from the Cumberland bituminous coal. Taking the mean result of the two anthracites, and comparing it with the result from the Cumberland coal, the evaporative efficiency of the former exceeds that of the latter by $19\frac{8}{10}$ per centum of the latter, and the *Pacific* owes the speed she made on the two voyages with Cumberland coal, principally to very favorable weather; which is further evidenced by the small amount of slip (only 15·62) made by the wheels on those passages.

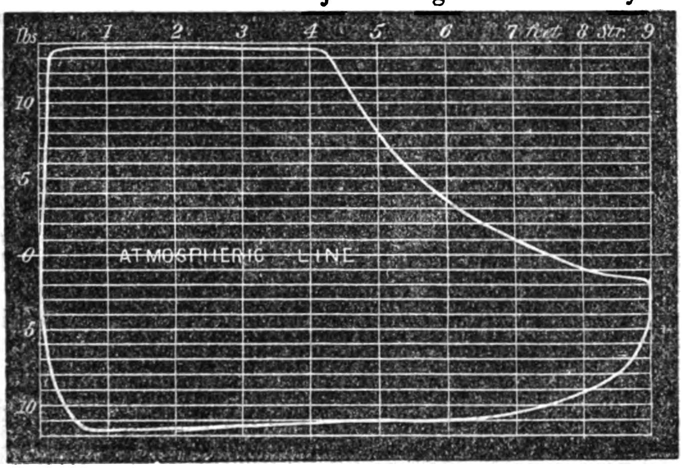
By referring to the *Journal* for last January, page 42, the fixed carbon

in Pennsylvania anthracite is given at 88·540 per centum, and in Welsh anthracite at 88·882 per centum, the mean of which is 88·711. The fixed carbon in Cumberland bituminous coal is 75·05 per centum for a mean of five varieties, as determined by Professor Walter R. Johnson. *The per centage of fixed carbon in the anthracites, therefore, exceeds its per centage in the Cumberland coal by* 18·2 *per centum of the latter. We have already seen that the evaporative efficiency of the anthracites exceeds that of the Cumberland coal by* 19·8 *per centum of the latter; or the evaporative efficiency of the two kinds of coal is sensibly in the proportion of their fixed carbon—a law well supported by a vast mass of experiments on steam boilers, with but an occasional exception, and now universally acknowledged by the best European authorities.*

The foregoing result is derived from the combustion of 1507 tons of Cumberland coal and 5494 tons of Anthracite, burned by expert engineers and firemen, under circumstances in which no efforts were spared to obtain the highest results from each.

By referring to the *Journal* for January last, where an account of the *Arctic* is given, it will be seen that the boilers of that vessel had a much less economical evaporation than the boilers of the *Pacific*. Now, the boilers of the two vessels are precisely alike in type and general proportions, the principal difference being that the vertical tubes, composing the chief part of the heating surface, are six inches the longest in the *Arctic*. The length of travel of the heated gases is the same in both vessels, as is also the area and height of the smoke chimney. Now, the fuel was of the same kind, and burned under the direction of the same engineer, and yet the *Pacific's* economical evaporation was 13 per centum of the *Arctic's* greater than the *Arctic's*.

INDICATOR DIAGRAM.—The subjoined diagram shows a very fair ave-



rage of all, taken from both ends of the two cylinders. They differ very slightly in difference from boiler pressure and in point of cutting off. The leading features of the diagram are a want of lead on the steam, and a cushioning on the exhaust. With this *set* of the valves, the engines were found to give their most satisfactory performance.

On some of the Eruptive Phenomena of Iceland. By Dr. JOHN TYNDALL, F. R. S.*

The Lecturer adverted to the Geisers; and proposed, as his time was limited, to confine his attention to the Great Geiser. We have here a tube ten feet wide and seventy feet deep; it expands at its summit into a basin, which from north to south measures fifty-two feet across, and in the perpendicular direction sixty feet. The interior of the tube and basin is coated with a beautiful smooth plaster, so hard as to resist the blows of a hammer. The first question that presents itself is, how was this wonderful tube constructed? How was this perfect plaster laid on? A glance at the constitution of the Geiser water will perhaps furnish the first surmise. In 1000 parts of the water the following constitutents are found:

Silica,	0·5097
Carbonate of soda,	0·1939
Carbonate of ammonia,	0·0083
Sulphate of soda,	0·1070
Sulphate of potash,	0·0475
Sulphate of magnesia,	0·0042
Chloride of sodium,	0·2521
Sulphate of sodium,	0·0088
Carbonic acid,	0·0557

The lining of the tube is silica, evidently derived from the water; and hence the conjecture may arise that the water deposited the substance against the sides of the tube and basin. But the water deposits no sediment even when cooled down to the freezing-point. It may be bottled up and kept for years as clear as crystal, and without the slightest precipitate. A specimen brought from Iceland and analyzed in this Institution was found perfectly free from sediment. Further, an attempt to answer the question in this way would imply that we took it for granted that the shaft was made by some foreign agency and that the spring merely lined it. A painting of the Geiser, the property of Sir Henry Holland, himself an eye-witness of these wonderful phenomena,—was exhibited. The painting, from a sketch taken on the spot, might be relied on. We find here that the basin rests upon the summit of a mound; this mound is about forty feet in height, and a glance at it is sufficient to show that it has been deposited by the Geiser. But in building the mound, the spring must also have formed the tube which perforates the mound; and thus we learn that the Geiser is the architect of its own tube. If we place a quantity of the Geiser water in an evaporating basin, the following takes place: in the centre the fluid deposits nothing; but at the edges, where it is drawn up the sides of the basin by capillary attraction, and thus subjected to a quick evaporation, we find silica deposited; round the edges we find a ring of silica thus laid on, and not until the evaporation is continued for a considerable time, do we find the slightest turbidity in the central portions of the water. This experiment is the microscopic representant, if the term be permitted, of nature's operations in Iceland. Imagine the case of a simple thermal spring whose waters trickle over its side down a gentle incline; the water thus exposed evaporates speedily, and silica is deposited. This deposit gradually elevates the side over

* From the London, Edinburgh, and Dublin Philos. Magazine, August, 1853.

which the water passes until finally the latter has to choose another course; the same takes place here, the ground becomes elevated by the deposit as before, and the spring has to go forward—thus it is compelled to travel round and round, discharging its silica and deepening the shaft in which it dwells, until finally, in the course of centuries, the simple spring has produced that wonderful apparatus which has so long puzzled and astonished both the traveler and the philosopher.

Before an eruption, the water fills both the tube and basin, detonations are heard at intervals, and after the detonation a violent ebullition in the basin is observed; the column of water in the pipe appears to be lifted up, thus forming a conical eminence in the centre of the basin and causing the water to flow over its rim. The detonations are evidently due to the production of steam in the subterranean depths, which rising into the cooler water of the tube, becomes condensed, and produces explosions similar to those produced on a small scale when a flask of water is heated to boiling. Between the interval of two eruptions, the temperature of the water in the tube towards the centre and bottom gradually increases. Bunsen succeeded in determining its temperature a few minutes before a great eruption took place; and these observations furnished to his clear intellect the key of the entire enigma. A little below the centre the water was within two degrees of its boiling point, that is, within two degrees of the point at which water boils under a pressure equal to that of an atmosphere, *plus the pressure of the superincumbent column of water.* The actual temperature at thirty feet above the bottom was 122° Centigrade; its boiling point here is 124°. We have just alluded to the detonations and the lifting of the Geiser column by the entrance of steam from beneath. These detonations and the accompanying elevation of the column are, as before stated, heard and observed at various intervals before an eruption. During these intervals the temperature of the water is gradually rising; let us see what *must* take place when its temperature is near the boiling point. Imagine the section of water at thirty feet above the bottom to be raised six feet by the generation of a mass of vapor below. The liquid spreads out in the basin, overflows its rim, and thus the elevated section has six feet less of water pressure upon it; its boiling point under this diminished pressure is 121°; hence in its new position, its actual temperature (122°) is a degree above the boiling point. This excess is at once applied to the generation of steam; the column is lifted higher, and its pressure further lessened; more steam is developed underneath; and thus, after a few convulsive efforts, the water is ejected with immense velocity, and we have the Geiser eruption in all its grandeur. By its contact with the atmosphere the water is cooled, falls back into the basin, sinks into the tube, through which it gradually rises again, and finally fills the basin. The detonations are heard at intervals, and ebullitions observed; but not until the temperature of the water in the tube has once more nearly attained its boiling point is the lifting of the column able to produce an eruption.

In the regularly formed tube the water nowhere quite attains the boiling point. In the canals which feed the tube, the steam which causes the detonation and lifting of the column must therefore be formed. These

canals are in fact nothing more than the irregular continuation of the tube itself. The tube is therefore the sole and sufficient cause of the eruptions. Its sufficiency was experimentally shown during the lecture. A tube of galvanized iron six feet long was surmounted by a basin; a fire was placed underneath and one near its centre to imitate the lateral heating of the Geiser tube. At intervals of five or six minutes, throughout the lecture, eruptions took place; the water was discharged into the atmosphere, fell back into the basin, filled the tube, became heated again, and was discharged as before.

Sir Geo. Mackenzie it is well known was the first to introduce the idea of a subterranean cavern to account for the phenomena of the Geiser. His hypothesis met with general acceptance, and was even adopted undoubtingly by some of those who accompanied Bunsen to Iceland. It is unnecessary to introduce the solid objections which might be urged against this hypothesis, for the tube being proved sufficient, the hypothetical cavern disappears with the necessity which gave it birth.

From the central portions of the Geiser tube downwards, the water has stored up an amount of heat capable, when liberated, of exerting an immense mechanical force. By an easy calculation it might be shown that the heat thus stored up could generate, under ordinary atmospheric pressure, a column of steam having a section equal to that of the tube and a height of nearly *thirteen hundred yards*. This enormous force is brought into action by the lifting of the column and the lessening of the pressure described above.

A moment's reflection will suggest to us, that there must be a limit to the operations of the Geiser. When the tube has reached such an altitude that the water in the depths below, owing to the increased pressure, cannot attain its boiling point, the eruptions of necessity cease. The spring however continues to deposite its silica, and forms a *laug* or cistern. Some of these in Iceland are of a depth of thirty or forty feet. Their beauty is indescribable; over the surface a light vapor curls; in the depths the water is of the purest azure, and tints with its own hue the fantastic incrustations on the cistern walls; while at the bottom is observed the mouth of the once mighty Geiser. There are in Iceland traces of vast, but now extinct, Geiser operations. Mounds are observed whose shafts are filled with rubbish, the water having forced a way underneath and retired to other scenes of action. We have in fact the Geiser in its youth, manhood, old age, and death, here presented to us:—in its youth, as a simple thermal spring, in its manhood as the eruptive spring, in its old age as the tranquil *laug*, while its death is recorded by the ruined shaft and mound which testify the fact of its once active existence.

Next to the Great Geiser the Stokkur is the most famous eruptive spring of Iceland. The depth of its tube is forty-four feet. It is not however cylindrical like that of the Geiser, but funnel shaped. At the mouth it is eight feet in diameter, but it diminishes gradually, until near the centre the diameter is only ten inches. By casting stones and peat into the tube and thus stopping it, eruptions can be forced which in point of height often exceed those of the Great Geiser. Its action was illustrated experimentally in the lecture, by stopping the galvanized iron tube before

alluded to loosely with a cork. After some time the cork was forced up, and the pent-up heat converting itself suddenly into steam, the water was ejected to a considerable height; thus demonstrating that in this case the tube alone is the sufficient cause of the phenomenon.

On the Condensation of Gases at the Surface of Solid Bodies. By MM. J. Jamin and A. Bertrand.*

In the various experiments intended to establish the physical theory of gases, it is implicitly supposed that their state of equilibrium is not influenced by the walls of the vessels in which they are contained; it is supposed that no attractive or repulsive force exists between solid and gaseous molecules. Nevertheless, the general principles of molecular physics do not justify our thinking that this can be the case; we have no reason to suppose that gases are deprived of a property so energetically manifested by liquids; and if it were so, we could not explain many phenomena which only require to be generalized in order to demonstrate the existence of this property.

Porous bodies present, in a very small space, a considerable amount of internal surface; the gases which penetrate into these substances lose their repulsive force, and accumulate in them as though by the influence of an extremely energetic attractive force. The phenomenon of porous bodies may be compared to that of capillarity; and just as the elevation of water in a tube may serve to show the existence of attractions between liquids and glass, the absorption of gases by charcoal is a proof of the attraction which a solid, isolated, and continuous surface may exert upon gases.

After ascertaining and measuring the absorption of gases by various porous bodies, De Saussure called the attention of chemists to an important fact, namely, that he had proved the gases condensed in charcoal produced abnormal chemical actions; since that time Döbereiner discovered spongy platinum: these combinations, anticipated by De Saussure, became more evident; but it was seen that they were preceded by a condensation of the gases, and, in fact, were the consequence of this; they consequently serve to prove it.

As soon as the discovery of Döbereiner was announced, Thenard and Dulong repeated his experiments with some variations. They ascertained that the properties of spongy platinum were possessed by porous bodies; they found them to exist in thin leaves of all the metals, and even in pounded glass or porcelain. Now if these combinations be the consequence of condensation, it must be admitted that this condensation takes place upon the metallic leaves and on the fragments of glass.

To these various experiments we must add the leading fact announced by M. Pouillet,—the absorption of oxygen in a platinum thermometer, and the condensation of the vapor of water by glass.

Moreover, this general idea admitted by geometricians, has often constituted the study of physicists, who, not hoping to prove it directly, have

*From the Lond., Edinb., and Dublin Philosoph. Magazine, August, 1853.

sought to verify it by indirect but very precise experiments. M. Arago proposed to cause the interference of two rays of light passing through the air, the one at a certain distance from, the other in contact with, a solid surface; he has recently returned to the same question, making use of the oscillations of a magnetized needle.

There exist, therefore, indirect proofs, which however to us appear conclusive, of the condensation of gases by solid surfaces; thus it was with nearly a certainty of success that we undertook the following experiments.

We filled glass vessels, which had been carefully measured, with pulverized solid substances; we ascertained the densities of the powders and the quantities contained in the vessels, and we had all the elements necessary for calculating the space left free.

Thus arranged, the vessels were connected with a good air pump and with a manometer with two branches; one of the two branches was open to the air; it allowed the pressures to be ascertained; the other was closed and communicated with the vessel by a tube and stop-cock; it served to measure a constant volume of gas, which was then driven into the vessel by causing the mercury to rise. At each introduction of gas the pressure increased by a quantity which was measured, and which could be calculated by Mariotte's law; the results of the experiment and of calculation were compared.

In this manner we have operated upon very various substances,—Fontainbleau sand, pounded glass of different degrees of fineness, and metallic filings and oxides. We have always found that the pressure observed was less than that calculated; we have therefore concluded that the gases were absorbed by the solid substances.

These absorptions present great analogy with those manifested by porous bodies; they are not produced instantaneously, but continue during several hours, only attaining their limit after a period which may be prolonged at pleasure; they vary in intensity according to the nature of the gas employed, being weak with hydrogen, stronger with atmospheric air, and very considerable with carbonic acid. We shall give their measure by the following results, obtained with pounded glass, washed and dried; the free space was 590 cubic centimetres, in which a vacuum was produced, and the gas was then allowed to fill it under the atmospheric pressure; it absorbed—

Carbonic acid.	Air.	Hydrogen.
645	602	595

We are convinced, moreover, that the preceding results are too low, and that it is impossible to measure exactly the quantities of gas contained in such spaces. When a vacuum is produced in them, the equilibrium of pressure is evidently re-established very slowly; the air-pump must be worked several hours to obtain a vacuum within 1 millimetre; and besides this, pressure does not remain constant, it gradually increases, and the action of the machine must be recommenced without ever being able to attain the maximum vacuum which it is capable of producing. The condensation obtained is the more energetic according to the goodness of the vacuum produced; but it is necessary to remember that its exact measure is never obtained.

Carbonic acid manifests these properties very energetically; when the powder with which the glass vessel is filled, whatever may be its nature, is exposed to this gas for the first time, it absorbs it rapidly, but on a second operation it has partially lost this property. The vessel already mentioned received, after evacuation, successive equal charges of this gas; the increase of pressure which they produced were measured, and by calculating the volume of the vessel by Mariotte's law, there were found—

721 cub. cent. 636 cub. cent. 629 cub. cent. 627 cub. cent. 622 cub. cent.

After these experiments a vacuum of the same degree was again produced, and the same successive introductions of gas being effected, gave—

644 cub. cent. 630 cub. cent. 621 cub. cent. 620 cub. cent. 616 cub. cent.

From these results we must conclude,—1, that the absorption takes place with the more energy in proportion as the original pressure is weaker; 2, that after having once absorbed a gas, the solid substance retains a considerable portion of it, of which it cannot be deprived, and which causes a proportionable diminution in its power of condensation.

These experiments require particular care, and can only be reproduced with very accurate apparatus; we will, however, describe one which any one may repeat without difficulty, and which will exhibit our results in a conclusive manner.

A fine powder (pounded glass or oxide of zinc) is mixed in a mortar with water which has been deprived of air, so as to form a clear paste without any bubbles of gas; this is poured into a flask with a long neck until it fills two-thirds of the bulb. After a short time the solid substance is deposited with a layer of water above it. A vacuum is then produced in the flask; at the first strokes of the piston the water rises, increases in volume so as to fill the flask, but no bubble of air makes its appearance; and if the cock of the air-pump be suddenly opened, the pressure is reproduced, and the fluid returns to its original volume with a rapidity which shakes the flask, and a sound like that of the water hammer. If the experiment be prolonged, and the vacuum completely formed, noticeable quantities of bubbles are produced.—*Comptes Rendus*, June 6, 1853, p. 994.

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*New Application of Photography—Daguerreotypes on Wood.**

Mr. R. Langton, wood engraver and draftsman, of Manchester, has produced some very successful and beautiful specimens of photography, taken by himself, on blocks of box-wood. This photograph, so taken, is quite ready for the application of the wood engraver's burin. It is impossible to say how greatly this will advance the process of wood engraving, especially by saving all the preliminary labor of the draftsman; which, in many cases, constitutes the chief element in both the time and the cost attendant on the production of wood-engravings of a high class. Even in many of the lower branches of the art, the new application of sun-drawing will be an invaluable auxiliary. For instance, it is an ex-

* From the London Civil Engineer and Architect's Journal, September, 1853.

ceedingly difficult matter to get accurate drawings of machinery, in perspective; mechanical draftsmen only represent it in plane; and artists are generally found extremely reluctant to employ a large amount of time so unprofitably as the drawing of a complicated machine in perspective demands. These photographs can now in a few seconds accomplish what it would require hours for the artist to effect; and in point of accuracy the instrument must ever have the preference. But great as will eventually be the boon which this new application of photography will confer on the practical art of wood engraving, it may be made more extensively valuable, as a cheap form of producing pictorial objects. By Mr. Langton's process portraits, landscapes, &c., could be produced on any smooth piece of wood, duly prepared; and thus even wooden snuff boxes, hand screens, &c., may be decorated with portraits or scenes from nature, or copies of works of art, at a cost much less than daguerreotypes on metal plates. Indeed, it is difficult to say where the applications and uses of this new process may not extend. The inventor does not limit his invention to its use in wood engraving, but claims for it an equally useful and valuable application in other directions, in connexion with practical art.

Weights and Measures. By W. B. Jack.*

The following remarks are submitted to us in reference to a paper read before the Society of Arts, on the 23d of February last, and reported in the *Athenæum* of three days' later date.—I wish [says the writer,] to mention, that the paper was of a very unpretending character, and was prepared by me in the spring of 1852, with the intention of being read before a very small association of gentlemen in this place. In the autumn of the same year, I perceived that the Society of Arts had formed a Colonial Committee, one of whose objects, as stated in an enclosure sent through the Colonial Office to the Lieutenant Governor of New Brunswick, is—"To make a comparison of coins, weights, and measures, as used in the Colonies, and to receive and discuss propositions for giving them uniformity." Having, therefore, the paper lying by me, I forwarded it, just as it was—thinking that one part of it might furnish some such information as was desired; but not at all supposing that it would be deemed worth reading before a formal meeting of such a body as the Society of Arts. I beg, however, to call your attention to a point which I regard as somewhat important, and deserving of further consideration; namely, the way in which I proposed to reduce our confused, perplexing, and incongruous tables of weights to one which would, nevertheless, include all the most essential denominations in each, and moreover be framed in a great measure according to the decimal scale. In Troy weight it is necessary to preserve the *grain*, or some simple multiple, or submultiple of it. The other denominations are much less frequently used, and can all be readily reduced to grains when needed. In Avoirdupois weight the pound cannot be dispensed with; and although the ounce is employed to a considerable extent in the retail trade, yet it is desirable

* From the London Athenæum, June, 1853.

on several accounts to abolish it; and to accomplish this would, I conceive, be neither very difficult nor hazardous. The following is the Decimal scale suggested:—

Grains.	Millozes.	Centoze.							
5 =	10 =	1 =	Socoze.						
50 =	100 =	10 =	1 =	Oze.					
500 =	1000 =	100 =	10 =	1 =	Pound.				
7000 =	14000 =	1400 =	140 =	14 =	1 =	Stone.			
98000 =	196000 =	19600 =	1960 =	196 =	14 =	1 =	Sekone.		
930000 =	1960000 =	196000 =	19600 =	1960 =	140 =	10 =	1	Hectone.	
9800000 =	19600000 =	1960000 =	196000 =	19600 =	1400 =	100 =	10 =	1	Kilone.
98000000 =	196000000 =	19600000 =	1960000 =	196000 =	14000 =	1000 =	100 =	10 =	1

In the table of long measure I have ventured to propose the *foot* instead of the *yard*, as recommended by the Commissioners in their Report of 1841, for the basis from which to proceed decimally,—inasmuch as a decimal multiple and submultiple of the former are in common use, more especially among engineers. In this colony the measures of capacity are in a most unsatisfactory state; but a Bill for regulating all weights and measures has been proposed for the consideration of the Provincial Legislature during their present session, and I think it will receive their sanction. My own prepossessions are strongly in favor of adopting the imperial measures; but I am obliged, reluctantly, to confess that it would be injudicious to attempt their introduction here, principally for the following reasons:—1. Because the old measures are retained in all the British colonies in North America, and in the West Indies, as also in the neighboring States of the Union.—2. Because all the liquid measures now in universal use throughout the colony would have to be replaced by the imperial, at no inconsiderable expense; and many old customs and habits would consequently be interfered with. The needless and mischievous distinction between liquid and dry capacity will be rendered less objectionable by a clause in the Bill, which orders that all grains, roots, &c., heretofore sold by stricken or heaped measure, shall henceforth be sold by weight, and that so many pounds of such articles, specially named, shall be deemed and taken to be a bushel. In this out-of-the-way corner of the world, the *Athenæum* has, for many years, been a solace to me, as one of the means of keeping up my connexion and acquaintance with the great world without.

Chinese Magic Mirrors.

To the Editor of the Franklin Journal.

In the October number of your *Journal*, I noticed an article translated from the French, ascribing the discovery of the cause of the phenomenon of the Magic Mirror to MM. Biot and Arago, of the French Academy. By referring to vol. xv. of the 3d series of your *Journal*, p. 52, you will find I gave precisely the same solution as that of the learned Academicians as early as 1847. Yours, respectfully,

J. J. Greenough, No. 6, Wall st., N. York.

Our esteemed correspondent must pardon us, but the explanation to which he refers us is by no means the same as that of the French Acade-

micians. He explains the phenomenon by "inequality of polish;" that is, that the surface on the figures is either more or less bright than the rest; but this will not account for the phenomena, because, according to the distance of the screen from the mirror, the figure is either lighter or darker than the ground.

The explanation of Messrs. Arago and Biot is, that the *curvature of the surface* is altered by the greater or less rigidity of the figures, and thus throw the focus of these parts at a greater or less distance from the mirror than that belonging to the general figure. This accounts for all the phenomena. EDITOR.

Remarks on the Structural Conditions of Iron. By T. R. V. FUCHS.*

The difference in physical characters presented by the several kinds of iron is generally attributed to the presence of a variety of substances, among which carbon is considered the most important. It is contained in all kinds of iron, almost always accompanied by silicon, which perhaps exercises the same influence. Raw iron contains the largest quantity of carbon, bar iron the least, and steel is in some sort intermediate between the two; but the quantity of carbon does not in any case bear a constant proportion to the iron, nor are these three kinds of iron separated from each other by any definite limits. These two facts are sufficient to show that the carbon cannot be in a state of very intimate combination with the iron, and there are no sufficient grounds for assuming that the different conditions of this metal are determined solely by the quantities of carbon contained in it. The numerous, and in many respects valuable, analyses of iron have served only to prove the truth of the above remark. Upon the gratuitous assumption that the varying per centage of carbon is the cause of the differences in the character of iron, attention has been too exclusively devoted to this point, while another, and perhaps more essential one, the crystalline structure, has been overlooked.

Fuchs expresses his conviction that iron is a dimorphous substance; that there are, in fact, two species (varieties) of iron,—the tesseral and the rhombohedral. He considers it as proved that malleable iron belongs to the tesseral system; and if any doubt still exists, it may be inferred from analogy that such is the case, inasmuch as all other malleable metals possess crystalline forms belonging to this system.

The crystalline form of raw iron has not been ascertained with so much certainty, but Fuchs considers it highly probable that it belongs to the rhombohedral system, because it comes within the class of perfectly brittle metals, the crystalline forms of which, as far as we are acquainted with them, are rhombohedral.

But the difference between malleable and cast iron does not consist merely in the crystalline structure, which may be open to doubt, but likewise in their physical characters, and to some extent in their chemical behavior; for instance, the cohesion, hardness, resistance to fracture, fusibility, oxidizability, solubility in acids, &c. He is of opinion that these circumstances alone would justify the inference that there is a spe-

* From the London Repertory of Patent Inventions, Nov. 1853.

cific difference between malleable and cast iron, which he compares with those presented by the modifications of sulphur, phosphorus, arsenious acid, by glass and Reaumur's porcelain.

Finally, with regard to steel, Fuchs is of opinion that it is an alloy of tesseral and rhombohedral iron. The per centage of carbon which it contains varies from 0·625 (Gay-Lussac) to 1·9 (Karsten). It cannot therefore be regarded as a definite and constant compound. It differs from other alloys in the circumstance that its characters may suffer considerable alteration without an accompanying addition or loss of substance, as in the hardening and softening of steel, changes which Fuchs supposes to be the result of an internal and alternating metamorphosis, by which the relative proportion of the two species of iron is altered. Thus, according to his views, in hardened steel the rhombohedral preponderates over the tesseral iron, and the reverse in soft steel. Very hard steel would, therefore, from the very small proportion of tesseral iron, approximate closely to cast iron; and this conjecture is favored by the low specific gravity of hardened steel. By the process of tempering, the proportion of tesseral iron in steel would increase with the temperature. The two kinds of iron in steel may be regarded as in a state of constant mutual tension, which may perhaps be the reason why steel retains permanently communicated magnetism, while malleable iron does not.

An experiment of Schafhäutl's* would appear to favour the above views. He submitted a piece of a razor-blade to the action of tolerably strong hydrochloric acid for several days, at the end of which time it was found to have been very unequally attacked. When washed, dried, and broken in a mortar, it furnished fragments, some of which could be powdered, while others were malleable.

With regard to the important and much-discussed question of the alteration of malleable iron when exposed to continuous vibration, concussion, or torsion, in consequence of which it requires a granular fracture, Fuchs admits that such an alteration takes place even in the best worked metal, but does not altogether agree with the explanation usually offered for it, viz., the gradual assumption of a crystalline texture; and is of opinion that it consists in the passage of the iron from a fibrous crystalline state to a granular crystalline state, a change in the aggregation, not an essential metamorphosis. When iron passes from the fibrous into the granular texture, the cohesion of the molecules is lessened; and by their aggregation into rounded groups a heap of distinct particles is produced, which may be compared with what mineralogists call granular minerals. The continuity of the mass is thus to some extent destroyed, inasmuch as these granular particles only adhere together more or less, and consequently the greater the size and number of these particles the greater is the diminution in tenacity. According to the statement of Kohn, the original condition of iron thus altered cannot be restored by heating to redness and forging, but only by exposure to a welding heat; and Fuchs considers this a sufficient proof that this alteration of iron consists in a breaking up of the continuity of the mass. The restoration of this continuity requires that the granular iron should, by exposure to a weld-

* Prechtl's *Technologischer Encyclopedie, Abhandlung uber den Stahl*, vol. xv., p. 377.

ing heat, be rendered amorphous, when the cohesive force again becomes active, a condition which in the case of most other bodies obtains only when they are liquid.—*Schweizerisches Gewerbeblatt, September*, 1852.

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*On the Economy by the use of Different Vapors in the Steam Engine.**

Dr. Apjohn made a communication, the object of which was to demonstrate the fallacy of the doctrine, that in order to produce a given volume of vapor, having a given elastic force, the same quantity of fuel must be consumed, irrespective of the nature of the liquids employed.

"It has been frequently proposed to substitute the vapor of some volatile liquid, such as alcohol or ether, for that of water in the steam engine, under the idea that by so doing fuel would be economized; and the proposal appears *primâ facie* plausible, seeing that the boiling points are not only lower than that of water, but that the same is true of their specific heats, and of the latent heats of their vapors. This idea would seem to have struck at different times the minds of different persons, and the Rev. Mr. Cartwright, a gentleman of great mechanical genius, and celebrated for his mechanical inventions, actually devised a most ingenious form of steam engine,† in which the piston was to be moved by the vapor of alcohol.

"Mr. Ainger, in a notice brought by him before the Royal Institution, London, in February, 1830, on the Economy of the Steam Engine, would seem to be the first person who publicly dissented from such views; and he has certainly the merit of having shown the insufficiency of the data generally used by those who, previous to his time, calculated that the substitution of more volatile liquids for water would lead to a considerable saving of fuel. The conclusion, however, at which he arrives, that, leaving the original cost of the liquids out of consideration, water would be as economical a liquid as alcohol or ether, I believe to be quite erroneous; and as the question at issue is one of some practical importance, I shall proceed to state succinctly the method of calculation which I have employed in discussing it, and the precise results at which I have arrived.

"As the vapors of different liquids have at their respective boiling points the same elastic force, equal volumes of them will produce equal mechanical effects. In order, therefore, to the solution of the question under consideration, it will only be necessary to calculate the weights of the different liquids, water included, which give equal volumes of vapors, and to determine the quantities of caloric necessary for the conversion of them into vapor.

"Now as the volume of a vapor, like that of any other form of matter, is represented by its weight or mass, divided by its specific gravity, if we put $\frac{x}{s'} = \frac{1}{s}$, x being the weight of any vapor, whose specific gravity is s', and s the specific gravity of the vapor of water, we will get $x = \frac{s'}{s}$, that is, the weight of any liquid which, at its boiling point, gives a vol-

* From the Proceedings of the Royal Irish Academy, 1851—2.

† See Philosophical Magazine, vol. 1.

ume of vapor equal to that given by a weight of water represented by unity at its boiling point, is got by dividing the specific gravity of the vapor by that of steam. But the specific gravities to be used in this computation are not those usually given in books, each of which is referred to a different unit, viz., air at the same temperature, and under the same pressure as the vapor, but the specific gravities of the vapors at the respective boiling points of the several liquids, compared to the standard unit, viz., air at 60°, and under a pressure of 30°. In the following tables, the former specific gravities are found in the second, and the others in the third column, the latter being in each case got by multiplying the former by $\frac{518}{458+t}$, t being the boiling point of the liquid which yields the vapor. In the fourth column we have the weights, which would give equal volumes of vapors, calculated by the expression $x=\frac{s'}{s}$ already given, the values of s and s' being taken from the third column.

1.	2. Specific Gravity referred to air at Boiling points.	3. Specific gravity at Boiling points referred to air at 60°.	4. Weights, giving equal volumes of vapor.
Water, .	·622	·480	1·000
Wood Spirit,	1·120	·950	1·979
Alcohol, .	1·613	1·322	2·754
Ether, .	2·586	2·397	4·993

"It is now easy to assign the quantities of caloric necessary to produce an equal volume of the vapor of each liquid at their respective boiling points, for these will obviously be represented by the expression $m\,c\,\{(t-50)+l\}$, m being for each liquid its number in column 4, c its specific heat, t its boiling point, and l the latent heat of its vapor at the temperature of ebullition. When, with the aid of the annexed table,—

	Boiling Points.	Specific Heats.	Latent Heats.
Water, .	212°	1·00	961·8
Wood Spirit,	151·7	·67	475·2
Alcohol, .	172·4	·64	374·4
Ether,	100·4	·50	163·8

which exhibits the specific and latent heats on which most reliance can be placed, the numerical calculation is made, the following are the results:—

Water, .	. 1129	1·000
Wood Spirit, .	764·8	·676
Alcohol, .	. 875·5	·775
Ether,	.- 534·7	·473

"The mere inspection of these numbers is sufficient to show that Mr. Ainger is in error, or that by substituting for water, wood spirit, alcohol, or ether, the same moving force will be obtained, and with a great saving of fuel. With wood spirit, about two-thirds, with alcohol, about three-fourths, and with ether, somewhat less than half the caloric required by water will suffice.

"To the use, however, of such liquids there are obvious objections. Their cost is considerable compared to that of water, and as they evolve at atmospheric temperatures vapors of a considerable elastic force, they

will, from imperfect condensation, resist the motion of the piston, and thus give rise to an appreciable loss of power. But, notwithstanding this practical difficulty, which, by the way, is not in the cases of alcohol and wood spirit one of a formidable nature, the theoretic conclusion is no less certain, that equal volumes of the vapors of different liquids, formed at their respective boiling points under the pressure of a single atmosphere, *do not* require for their production equal quantities of caloric."

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, November 17, 1853.

Samuel V. Merrick, President, in the chair.

Thomas Fletcher, Vice President.

John F. Frazer, Treasurer.

William D. Parrish, Recording Secretary, P. T.

The minutes of the last meeting were read and approved.

Letters were read from L'Ecole Nationale des Mines, Paris; The Royal Geographical Society, London; and John Marston, Esq., U. S. Navy.

Donations to the Library were received from L'Ecole Nationale des Mines, and La Societie d'Encouragement pour l'Industrie Nationale, Paris; The Society of Arts, The Institute of Actuaries, The Royal Geographical Society, London, and the Royal Polytechnic Society, Falmouth, England; Prof. A. D. Bache, Coast Survey Office, Judge Mason, Commissioner of Patents, and William Chauvenet, Esq., D. C.; The Legislature of the State of Pennsylvania; The Councils of the City of Philadelphia; Dr. J Kirkland, Cleveland, Ohio; John Marston, Esq., U. S. Navy, and Charles Hartshorne Esq., Philadelphia.

Donations to the Cabinets, from Messrs. Merrick and Sons, Wm. W. Fleming Esq., Philadelphia.

The Periodicals received in exchange for the Journal of the Institute were laid on the table.

The Board of Managers and Standing Committees reported their minutes.

The Committee on Exhibitions presented so much of their report on the late Exhibition, as refers to the articles manufactured by the Hamilton Woolen Co., Southbridge, Mass., deposited by Messrs. H. Farnum & Co., and recommend the award to them of a *Gold Medal* for their superior Delaines and Cashmeres.

On motion, the medal was awarded in accordance with the report.

Resignations of membership in the Institute (54) were read and accepted.

New candidates for membership in the Institute (134) were proposed, and the candidates (11) proposed at the last meeting were duly elected.

Mr. Fairman Rogers exhibited and described the Bourdon barometer, an instrument upon the same principle as the pressure gauge by the same inventor. It consists of a thin, flat, metallic tube, bent into the form of a circle, the two ends nearly meeting, hung by a point in the middle of its

length, so that the equal motion of its ends will compensate for changes of temperature.

The two ends are attached to a lever having at one extremity a circular rack, which acts upon a pinion on the axis of the index hand. The communication between the air inside the tube and the atmosphere being entirely cut off, the varying barometric pressure of the atmosphere will cause a contraction or expansion of the tube, which is registered by the index hand.

Mr. Rogers also exhibited a triangle and rule arranged for drawing parallel lines at any given distance apart. A neat little instrument for the hatched lines in plans, or machine drafting. Also, a small instrument termed a map-meter, consisting of a circular metal disk three-quarters of an inch in diameter, with a chamfered milled edge, which moves as a nut on a screw three-quarters of an inch long, held between two arms of the handle of the instrument. It is designed to measure any sinuous line upon a map, such as a road or river. The disk is screwed along upon its axis until it jams against one of the cheeks of the fork which holds it; the instrument is then held upright with the lowest point of the circumference of the disk upon the end of the road to be measured, and moved over the line, the disk moving along the axis, one thread for each revolution. When the end of the line is reached, the lowest point of the disk is placed upon the zero point of the scale of distances, and moved in the opposite direction until it jams against the side of the fork, having necessarily made an equal number of revolutions, and traversed the same distance on the scale as on the map.

G. W. Smith exhibited to the meeting the working drawings, consisting of elevations of the facade and flanks of a church, now in progress at the N. W. corner of Broad and Mulberry Streets, Philadelphia; S. B. Button, Esq., architect. The edifice is of brown stone in the Byzantine or Romanesque style, having four dissimilar towers at the angles; the one at the S. E. corner being capped by a lofty octagonal stone spire rising to the height of 226 feet from the ground; the arches in the building, string-courses, &c., being highly enriched with foliage and other reliefs, boldly and elaborately sculptured. It is the first instance in this style among the ecclesiastical edifices of this City, at least of any magnitude.

Mr. S., after commenting upon the various contrivances which have been adopted or proposed for the prevention of the bursting of water pipes by the sudden shock or check of the momentum of the water when in motion, and the causes of their failure, presented to the meeting a plan which he believed would be efficient, economical, and lasting; a small hollow sphere, or other box, containing in its cavity communicating with the pipe within the stop cock, a sphere or other suitable mass of vulcanized india rubber enclosed therein, will receive the shock from the water when suddenly stopped, and thus greatly exhaust its force, and thereby preserve the pipe from injury.

The following communication was written for the *Journal*, in 1845, but its publicaton having been accidentally omitted, was presented to the Institute at a former meeting; the omission is now herewith supplied.

"On the Perpetual Ventilation of the Great Pyramid of Egypt, by G. W. Smith.

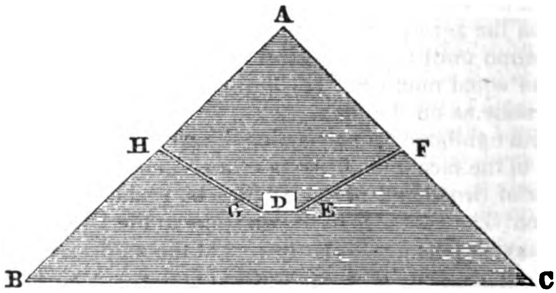
"This method of *Solar ventilation*, which has so recently been applied in

the United States is nevertheless the most ancient in existence; having been applied at least 4000 years ago in that most venerable monument of Egypt, the great pyramid of Cheops, (Khoufou or Suphis).

"In the first volume of Vyse on the pyramids of Gizeh, page 286, a description is given by Colonel Vyse of operations for removing the obstructions from two narrow apertures or tunnels, which ascend from the great chamber near the centre of the pyramid to the surface in an inclined direction.

"These had long been conjectured to be ventilators, and when the rubbish had been removed from them, the previous conjectures proved to be correct. The suffocating mephitic air of this, the King's chamber, was immediately changed by a rush of pure air from without.

"The manner by which these air channels acted when the present entrance passages were closed, has not hitherto been explained, Mr. G. W. S. stated, by any writer on these monuments. As the mode of action is extremely simple and efficient, and the very durable apparatus entirely self-acting, requiring no attention whatever, being moreover in as perfect a condition as on the remote day when it was finished, 120 generations ago, it deserves our attention. An inspection of the diagram will exhibit the plan at a glance.



A B C, The pyramid in section. The closed passages are not represented.
D, The King's chamber.
E F, The north air channel.
G H, The south air channel, "which being more heated from the sun's rays striking on the south side of the mass A B, the air will be heated, and thus rarified will rise in it by the pressure of the dense column in the northern or cooler side of the pyramid, day and night forever."

"During the process of building the chamber, and until the external casing of the pyramid was added, it cannot be doubted, that the action would be perfect; but even when cased, the joints would not be perfectly air tight, and therefore would permit some circulation of air.

"Mr. S. stated, that recently in this city, advantage had been taken of certain brick walls containing flues; the walls being heated by the sun to which they were exposed, rarified the air in the flues which communicated at their lower portions with the apartments to be ventilated, and the plan has been found, even with thin walls, quite effectual, and was strongly recommended for adoption in many places where it might be applicable.

COMMITTEE ON EXHIBITIONS.

Address delivered at the close of the Twenty-Third Exhibition of American Manufactures, held by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, from October 18th to November 3d, 1853. By George Harding, Esq.

The Committee on Exhibitions have invited me to deliver the closing address this evening. Deeply sensible of the honor thus conferred, and feeling the warmest interest in the success of our Institute, I have ventured to accept their invitation. I fear that you will have reason to regret that their choice had not fallen upon one better fitted by age, occupation, and experience for the performance of this duty; or that a personal sense of unfitness had not, on this occasion, constrained me to decline.

With regard to the exhibition about to close, I need speak little. To tell you that it surpasses its predecessors, and has elicited the admiration of the community, is but to say that the mechanics of Philadelphia have displayed the fruits of one more year of labor and of genius; and that this has been appreciated by a discriminating public.

The promotion of the mechanic arts is the object for which this Institute was organized. Its agents in accomplishing that purpose are the stimulus of rivalry excited by annual exhibitions, and its provisions for systematic instruction in the application of science to the arts and manufactures. I have thought, therefore, that a sketch of the progress of the mechanic arts, as fostered, in times past, by these means, would be an appropriate, and, perhaps, not an uninteresting subject.

My principal aim in this will be to show that the present advancement of our arts and manufactures results from, and their future progress is dependant upon, the intimate union of Science with Art.

The world was nearly six thousand years old before philosophy assumed her true position and became the handmaid to the arts. From the time of Socrates down to the middle of the sixteenth century, philosophy despised and neglected art, and art pined and dwindled for want of her aid. Philosophy preferred rather to devote herself to vague and impracticable theories of moral perfection, to subtle and unmeaning disputations. When she did deign to study natural and physical objects, such study was regarded merely as a mental exercise or diversion.

It is curious to observe to what extent this aversion of philosophy from art was carried under the sway of the lofty intellects of Socrates, Plato, and Seneca. Plato considered geometry as degraded by being applied to any useful purpose. Archytas, who lived about four hundred years before Christ, constructed machines of great ingenuity and considerable power upon mathematical principles, and is even said to have made a mechanical pigeon which could fly. Plato remonstrated with his friend Archytas, telling him that he was degrading a noble intellectual exercise into a low craft, that the true office of geometry was to discipline the

mind. From that time all the mechanical arts were considered as unworthy the attention of a philosopher.*

Archimedes far exceeded all other men of ancient times in mechanical ingenuity. He was familiar with the doctrine of specific gravity, and practically applied it in detecting the fraud of King Hieros' jeweller, in debasing the crown. When Marcellus besieged Syracuse, Archimedes, from the walls of that city, raised out of the water and destroyed the hostile galleys, or hurled great stones into and sunk their ships; and by means of mirrors he so concentrated the rays of the sun as to burn the fleets of the enemy at a distance. So highly was this man esteemed for his mechanical construction, that, when Syracuse was taken and sacked, his house alone was ordered by Marcellus to be spared. And yet, such at that time was the disposition of philosophy towards the mechanic arts, that Archimedes expressed himself ashamed of these great works; and it was with difficulty that he could be persuaded to divert his mind to them, from mere speculations and abstractions. He regarded his great mechanical works as trifles, with which a mathematician was permitted only to amuse himself.†

A distinguished writer, in the time of Cicero, once ventured to enumerate among the humble blessings which mankind owed to philosophy, the discovery of the principle of the arch, and the introduction of the use of metals. Seneca regarded this as an *insult* to philosophy, repelled it, and indignantly replied to him that philosophy had nothing to do with teaching men to rear arched roofs over their heads; the true philosopher does not care whether he has an arched roof or any other roof; to impute to a philosopher any share in the invention of a plough, a ship, or a mill, is an insult.‡

Such being the state of ancient philosophy, it is not to be wondered at that, for nearly six thousand years, the mechanic arts, despised and neglected, made but small advances. While Greece and Rome, in poetry, eloquence, statuary, and painting, attained to a degree of perfection unsurpassed in modern times, their mechanic arts remained almost stationary. Homer and Virgil are models for the poets of the present day. Men still revert to the glorious age of Athenian eloquence. The fame of Phidias, the sculptor, and of Apelles, the painter, have survived the shock of time which has destroyed the canvass and crumbled the marble. But the natural philosophy of Aristotle and Plato vanished before the light of modern science as suddenly as their moral theories did before the blaze of Christianity.

The human mind was misled by this false doctrine of philosophy until the close of the 16th century. It was then forever overthrown and demolished by Bacon. He taught a new doctrine. He exhorted men to consider the true end of knowledge, and not to seek it for the gratification of their minds, or for disputation, or that they may despise others, or for emolument, or for fame or power, or such *low objects;* but for its *intrinsic merits* and the *purposes of life.* "The greatest error of all the rest," he said, "is the mistaking or misplacing the last or furthest end of knowledge, for men have entered into a desire of learning and knowledge; sometimes,

* Plutarch's Life of Marcellus.
† Plutarch's Life of Archimedes and Marcellus.
‡ Seneca's Epistles.

upon a natural curiosity and inquisitive appetite; sometimes, for ornament and reputation; sometimes, for victory of art and contradiction; seldom, sincerely to give a true account of their gift of reason to the benefit and use of men. * * * * But it is that which will, indeed, dignify and exalt knowledge, if contemplation and action may be more nearly and straitly conjoined and united together."*

From Bacon, men first learned that science and the arts should walk hand in hand together, and since his day they have so journeyed. The good of mankind, thenceforth, became the aim of Philosophy. Deep was the root which the new doctrine took in the minds of men, and from it has grown the tree of modern science.

Bacon died in 1626. The tumults and troubles of the reign of Charles I., the revolution of 1642, and the disorders which ensued, for a time, delayed the progress of science; but immediately after the restoration, in 1660, it began to advance with rapid strides.

About the year 1660, the Royal Society commenced its operations. This Society was originally founded directly upon the motto and the philosophy of Bacon.† The earliest records we have of its sessions date in the year 1664, and these show that much attention was given by it to the mechanic arts. During the very first year of its existence, one member was directed to bring in an account of iron, from the ore to the bar; another, to inquire into the manufacture of hats; another, into the making of lead; a fourth, delivered a full and elaborate report on the history of the manufacture of cloth, as then in use. Tracts were read on the art of marbling paper, and on the refining of gold. Much of the time of the Society, however, was devoted to researches in agriculture and medicine, which had been also neglected under the old philosophy.

The barbarous state in which science had been left by the Alchemists, greatly embarrassed their early investigations. Many fables and falsehoods had been bound up with a little true knowledge, and a large portion of their time was occupied in investigating subjects which now excite our ridicule when mentioned. Thus, their recorded transactions inform us that on one occasion a member was ordered to provide some fresh hazel-sticks to try the experiment vulgarly called the divining-rod. Another member was subsequently ordered to bring his box of little animals called the death-watch; and at the next meeting, there were accordingly produced before the academy two of these insects for inspection and experiment.

On the 5th of June, the Duke of Buckingham was enrolled a member, and contributed a piece of unicorn's horn. The Society proceeded to try an experiment with it, recorded in the minutes as follows:—"A circle was made with powder of unicorn's horn, and a spider set in the middle of it, but it immediately ran out. The trial being repeated several times, the spider once made some stay on the powder."‡

* Bacon.—"Advancement of Learning," 174.

† The Royal Society was an attempt to reduce to practice Bacon's fiction of the New Atlantis. The influence of Bacon was not limited to England—it extended to France, and eventually throughout the Continent. In 1621 Bacon corresponded with Beranzon, an eminent professor in Savoy, in reference to his project for scientific investigation and discovery. And Des Cartes, who was one of the original founders of the French Association, the basis of the present National Institute of France, shows by his letters to Mersenne, in 1642, that he was familiar with, and entertained the most profound respect for the works of Bacon.

‡ Birch's History of the Royal Society, pp. 26, 84, 270, 383.

The instrumental collection of the Society appears, during the first year, to have been limited, showing the low state of experimental science at that day. An air-pump, presented by Boyle, a rude microscope, and a loadstone, seem to have comprised their collection. With these, however, they conducted a great variety of experiments. Every thing that was deemed worthy of investigation was either placed under the air-pump or submitted to the microscope. The academy were, nevertheless, proud of their instruments; their experiments were tried with great solemnity, and foreign ambassadors and princes were taken with pomp to see them.*

Two mechanical inventions were before the Academy that year. One was the scheme of an improved engine for carriage, of such a one as goes by one wheel and is drawn by one horse. The society ordered a model made of it, and at the next meeting was produced the modern wheel-barrow made in pasteboard. The second invention was a bow-gun for shooting whales, subsequently abandoned. During the same year, information was received as to the state of one of the arts in the American colonies, then in their infancy. The process reported upon has probably been lost in the lapse of years; it was the art of killing rattlesnakes in Virginia. The outline of this process is thus recorded: "Some leaves of the wild penny-royal were bruised, and these were tied in the cleft of a long stick; this was then held to the nose of the rattlesnake, who, by turning and wriggling, labored as much as he could to avoid it; but he was killed with it in less than half an hour; and, as was supposed, by the scent thereof."†

At the same meetings at which these, to us, apparently so trivial subjects were discussed, investigations were presented which resulted in our present form of barometer, in a portion of our present theory of heat and cold, and in improved modes of making lenses. This, too, it will be remembered, was only six years before the immortal Newton, in the 23d year of his age, communicated to the Society his theory of light, and commenced that brilliant career which during sixty years shed such lustre upon their proceedings.

From our present height of science, we can look back and behold these pioneers clearing the plain below, now gradually surmounting the obstacles in their course, now wandering backwards for a space, oft times delayed by the accumulated rubbish of old philosophy, but still steadily advancing, having truth—real, substantial, beneficial truth—for their object, and the omnipotent philosophy of induction for their guiding strength; until in the lapse of time we behold their Gregory, Davy, Wollaston, Cavendish, Brewster, Daniels, Farraday, and their compeers, fixing the utmost verge of earth for their bounds; and Newton and Herschel, the highest heavens for their resting place.

The Royal Society subsequently devoted its attention more especially

* Macaulay tells us, that Chief Justice Hale and Lord-keeper Guilford stole a portion of time from their judicial labors, to write treatises on hydrostatics. King Charles spent much time in his laboratory at Whitehall. "It was almost necessary to the character of a fine gentleman to have something to say about air-pumps and telescopes: and even fine ladies, now and then, thought it becoming to affect a taste for science, went in coaches and six to visit the Gresham curiosities, and broke forth into cries of delight at finding that a magnet really attracted a needle, and that a microscope really made a fly look as large as a sparrow." Macaulay, Hist. of England, p. 380. Pepey's Diary, May 30, 1667.

† Transactions Royal Society, No 3, p. 43.

to the advancement of science, as distinguished, from its application to the useful arts, and there sprung up in London, about a hundred years ago, another society, formed for the purpose of effecting a more direct union of science and art. That society was arranged much upon the same general plan as the Franklin Institute. It had its library, collections of models and machines, distributed premiums for inventions, improvements, and superior workmanship; and for nearly seventy years has published an annual volume of transactions. It was the first society which thus brought home to the practical mechanic the means of intellectual improvement in his profession. By its agency the position of mechanics was elevated in England, and the arts greatly advanced. This society arose at a fortunate era in the history of the Mechanic Arts—the era of the steam engine. At that time James Watt was fifteen years old; fourteen years afterwards he gave to the world his immortal discovery.

And here let me remind you how far he thus contributed, beyond all other men, to the lasting comfort, happiness and glory of his race. In 1769 he converted a simple fire-pump into an engine of boundless power. Nearly a hundred years have elapsed since then, and yet it remains, substantially, unchanged. For eighty years that engine has toiled with the strength of millions of horses, for all men, in every land. Above the wreck of electro-magnetic and hot-air engines, the fame of James Watt, in undiminished splendor, towers proudly eminent. To his genius the hundreds of thousands of our fellow-men in the manufactories of Great Britain, France, and Germany, owe their daily bread; on every navigable river, lake, and sea, on the mountain top and in the deep mine, his engine is working out man's purposes. It has caused towns and cities to spring up and flourish on the barren rocks of New England; it melts, pounds, and rolls the iron of Pennsylvania, and gladdens our ears with the hum of a hundred workshops. It has given to the South a world-wide and insatiable market for its staple; it has filled the Valley of the Mississippi with vigorous life and abundant wealth, carrying its harvests to the East, and bringing back in return the products of manufacture and the rich spoils of commerce. The iron-road, which is but its pathway when it moves upon the earth, binds together the people of our thirty-one States by a tie as strong as our Federal Constitution. To that engine the works of Arkwright, Fulton, Fitch, and Whitney owe the exigency which brought them forth, and the energy which gave them life. Itself the greatest of inventions, it has called forth the highest ingenuity in others. Itself the strongest of mechanical powers, it has rendered available the greatest human strength. If Bacon gave to science the word of truth, Watt gave to art the arm of power.

Fidelity to my subject would require me to trace the organization of associations similar to the Royal Academy throughout Europe; to narrate how the great Colbert, at the instigation of Louis XIV., founded in 1666 the Academy of France; that Society which, in the words of David Brewster, "has stood unshaken and active amid all the revolutions and convulsions which so long agitated that noble, but distracted country; a common centre of affection, to which antagonistic opinions, rival interests, and dissevered hearts have peacefully converged." It would further be my duty to show how, in rapid succession, there sprung up at St. Peters-

burg, at Stockholm, at Berlin, Edinburgh, Dublin, Copenhagen, Brussels, and Turin, similar academic bodies, bright towers of science, whose light illumined the whole continent, and was, in time, reflected back by many stately halls reared to industrial art. Passing thence to our own country, and later days, I should call to mind the origin of the American Philosophical Society, and the establishment of our own Institute in 1824; her early struggles, her subsequent prosperity, and how, for thirty years, she has labored strenuously to unite the interests of the professor and the mechanic. The distinguished success achieved by many of her members—by many, whose presence here forbids my further speaking of them—her reported experiments on water wheels, on boiler explosions, on the strength of metals, and others in high repute throughout the scientific world, her large library, her crowded exhibitions, and her able Journal, testify how faithfully she has carried out the purposes for which she was organized.

I fear, however, that this detail would become tedious to you; the encouragement of mechanic arts through the medium of Exhibitions, demands, moreover, a brief attention.

The Marquis d'Aveze was appointed Commissioner of Royal Manufactories in France, in 1797. He found that two years of neglect had reduced the workmen almost to starvation, and he then conceived the idea of converting the Chateau of St. Cloud into a bazaar, for the exhibition and disposal by lottery of the tapestry, china, and carpets, unsold and stored in the warehouses of the principal manufactories. A decree of the Directory, in the same year, however, banished him along with other nobles from France. He was permitted to return in the succeeding year, and then carried out his original plan at the Maison d'Orsay. The project was eminently successful, and attracted the notice of the French Government. That government then erected a Temple of Industry, which was filled with the most beautiful manufactured objects of France. On that occasion the practice of determining the relative merit of contributors and of distributing prizes by committees, originated. This exhibition was so successful that it was determined to repeat it annually.

The troubles of the French nation delayed its repetition until 1801; the third was held in 1802; the fourth in 1806. The wars of France delayed the fifth until 1819. Six others succeeded at intervals of five years, the eleventh exhibition having taken place in 1849, in the Champs Elysée. To their popularity is the origin of the Society of Encouragement to be traced—a society similar to our own, founded about 1804, and which has greatly promoted French art and manufacture.*

These exhibitions, it will be remembered, were all carried on by the government. The attention of the "British Society of Arts," was directed to the importance of the subject, about 1847, when their first public display was made. The Franklin Institute gave its first exposition of American manufactures in 1824.

Thus, it will be seen that this Institute is entitled to the merit of being the first society in this country, and probably in the world, which, by its own unaided resources, established this great fostering agent of the mechanic arts. Her example has since been followed by societies at New York, Boston, Manchester, Leeds, Dublin, Baltimore, and Washington.

* London Art Journal. 1851.

Like the associations from which they spring, they are now generally considered as the necessary incident and legitimate exponent of every manufacturing and mechanical community.

It is to the "Society of Arts," of London, whose origin and early history we have already traced, that the world is indebted for an exhibition in which the mechanical industry of all nations was represented. The design of the great fair of 1851, at Hyde Park, was entrusted to a local committee of that Institute, in June, 1845; and, after great exertion, they succeeded, with the aid of Prince Albert and the Royal Commissioners, in completing their work on the 1st of May, 1851. That exhibition was but a development of our own annual expositions; yet, when we regard its extent, magnificence, and results, it cannot but be viewed as the most remarkable event of modern times.

A space of nineteen acres in Hyde Park was enclosed, and covered by a building 1848 feet long by 408 feet wide, and 108 feet high in the centre. The cost of this structure was $713,900. The value of the articles exhibited was about twelve millions of dollars. Forty nations contributed to the exhibition, and over six millions of people visited it. From Norway, on the North, down to the Cape of Good Hope, on the South; from China, in the East, to Chili, in the West; from Ancient India and Egypt; from Moslem Turkey; from Guinea, on the Coast of Africa; from New Zealand, in the South Pacific; and from the solitary isle of Malta, they were there. *Then*, for the first time, was witnessed the spectacle of ships of war discharged of their armaments, and converted into transports of the mechanic arts. *There*, for the first time in the history of the world, the authorized representatives of thirty nations were assembled on a foreign soil, commissioned on no hostile errand, on no ordinary diplomacy. There, for the first time since the Crusades, were the nations of Europe allied together for a purpose which religion deemed worthy of its sanction.

Surely it seemed that the sword was about to be beaten into the ploughshare, and the art of war to be no longer learned by men. When the Royal Commissioners resigned their commission at the inauguration, the chairman announced the object of their work to be to conduce to the common interests of the human race, by encouraging the arts of peace and industry, and strengthening the bonds of union among the nations of the earth; and to promote a friendly and honorable rivalry in the useful exercise of those faculties which have been conferred by a beneficent Providence for the good and the happiness of mankind.*

Thus we have seen how science and art, united together, have in times past advanced. Let us turn to the future. A striking lesson which the progress of the arts at the present day teaches us is, the high social position which those engaged in mechanical pursuits are assuming throughout the world. As illustrative of this, I need only refer to the fact that in France, the medals awarded to Frenchmen, at the Hyde Park Exhibition, were distributed by Louis Napoleon in person; and the decoration of the Legion of Honor conferred upon the most successful exhibitors. The Grand Duke of Tuscany has recently, with great pomp and ceremony, established a new order of honor, called the order of "Industry." And aristocratic England has, at length, discovered that it is high time to abolish

* Official Report of Royal Commissioners, at opening of Hyde Park Bldg.

the distinction between the industrial and the, so called, learned professions. An eminent fellow of the Royal Society lately held this language: "Industry, to which England owes her success among nations, has never been raised to the rank of a profession. For her sons there are no honors, no recognised or social position. The restriction of learned honors to three recognised professions, has a lamentable effect, both on the progress of science and industry. Its consequence is, that each profession becomes glutted with ambitious aspirants, who, finding a greater supply than demand, sink into subordinate positions, becoming soured and disappointed, and, therefore, dangerous to the community. Raise industry to the rank of a profession; give to your Industrial Universities the power of granting degrees involving high social recognition to those who attain them, and you will draw off the excess of those talented men to whom the Church, the Bar, and Medicine, afford only a slender chance of attaining eminence."*

American mechanics, however, need neither legions of honor, orders of industry, or learned titles. The position which they may attain was fixed at an early day. It was fixed when the Philadelphia printer, in 1776, sat with Jefferson and three others to draft the Declaration of Independence; when the same printer signed the treaty of 1778, by which, for the first time, America was recognised as a nation of the earth; when, amid the splendor of the French Court, kings, royal beauties, and learned savans vied with each other in doing homage to the same printer, the conqueror of the forked lightning, our own Franklin. American mechanics know how largely they have contributed to the formation, wealth, and prosperity of this republic; that the want of a government which should protect and render uniform their interests, was a main cause of the adoption of the present constitution; that from that time down to the present, their interests have given rise to our great national questions, our division of parties, and have elicited the highest eloquence of our statesmen. They know that the genius of this government, which recognises no titled distinctions, will accord to the exertions of their right arms, and of their intellects, their full meed of social reward.

Another, no less striking, lesson taught us is the great conflict going on throughout the world for precedence in the mechanic arts; and that those nations which would win the struggle must render science more and more subservient to art—that practice and science must join together in a more solemn union. England was forced to admit that France had beaten her, and on her own soil. Eminent Englishmen conceded that France had surpassed them in the display of mechanic arts at Hyde Park. No sensible man doubts where the cause of France's victory lies. That it lies in her Central College of arts and manufactures, at Paris, in her School of mines, in her Conservatory of arts and manufactures, and in her Industrial Colleges at Ange, at Chalons, and at Aix, where hundreds, nay, thousands, of the most intelligent French youth are annually educated in the practical application of science to the mechanic arts and manufactures.

The nations of Europe have looked to this with deep anxiety, and are rousing themselves to the contest.

*Tract "On the National importance of studying abstract Science, with a view to the healthy progress of industry, by Lyon Playfair."

England thus speaks by Playfair, one of her Commissioners at the Exhibition of 1851: "All European nations, except England, have recognised the fact that industry must, in future, be supported, not by a competition of local advantages, but by a competition of intellect. Their thinking men have proclaimed it; their Governments have adopted it as a principle of State, and every town has now its schools, in which are taught the scientific principles involved in manufactures; while each metropolis rejoices in an Industrial University, teaching how to use the alphabet of science in reading manufactures aright. Were there any effects observed in the Exhibition from this intellectual training of their industrial populations? The official reserve necessarily imposed upon me as the Commissioner appointed to aid the Queen need exist no longer; and from my personal conviction, I answer without qualification in the affirmative. The result of the Exhibition was one that England may well be startled at. Wherever, and that implies almost every manufacture, science or art was involved as an element of progress, we saw, as an inevitable law, that the nation which most cultivated them was in the ascendant. Our manufacturers were justly astonished at seeing most of the foreign countries rapidly approaching and sometimes excelling us, in manufactures, our own by hereditary and traditional right."*

The illustrious Liebig proclaims from the continent, "that the great desideratum of the present age is practically manifested in the establishment of schools, in which the natural sciences occupy the most prominent place in the course of instruction. From these schools a more vigorous generation will come forth, powerful in understanding, qualified to appreciate and to accomplish all that is truly great, and to bring forth fruits of universal usefulness. Through them the resources, the wealth, and the strength of empires will be incalculably increased."

The venerable Humboldt, with almost inspired authority, thus counsels: "The most superficial glance at the present condition of European States shows that those nations which linger in the race cannot hope to escape the partial diminution, and, perhaps, final annihilation of their resources. It is with nations as with nature, which, according to a happy expression of Goethe, knows no pause in ever increasing movement, development, and production—a curse ever cleaving to standing still.

"Nothing but serious occupation with chemistry and natural and physical science can defend a State from the consequences of competition. Science and information are the joy and the justification of mankind. They form the springs of a nation's wealth, being often, indeed, substitutes for those material riches which nature has in many cases distributed with so partial a hand; those nations which remain behind in manufacturing activity, by neglecting the practical application of the mechanical arts and of industrial chemistry, to the transmission, growth, or manufacture of raw materials; those nations, among whom respect for such activity does not pervade all classes, must inevitably fall from any prosperity they may have attained, and this, by so much the more certainly and speedily, as neighboring States instinct with the power of youthful renovation, in which science and the arts of industry operate to lend each other mutual assistance, are seen pressing forward in the race."

* Lecture before the Society of Arts, on results of Exhibition of 1851.

In this great struggle between the nations of the earth, what position are American mechanics to assume? Will they scorn these admonitions, and disregard these lessons of experience? Will they not rather call upon science to gird up her loins, and to strike for them in the battle?

In what manner the colleges and schools of our country have been, or may now be, accommodating themselves to this new state of things, it would be presumption in me to say. But I may be excused, perhaps, in addressing a word to the men of my own age, and to younger men, on the facilities afforded by the organization of this Institute to carry out the principles of the great mechanical progress going on around us.

Elementary science, the practical development of scientific principles in organized machines and processes, and prompt information as to the advancement of scientific discovery, here and abroad, constitute the proper basis of study for the formation of mechanical intellect. To provide these, the organization and resources of the Franklin Institute are amply sufficient. Its annual course of lectures on elementary science, by professors of acknowledged ability; its large collection of treatises on theoretical and applied science; its committee meetings of learned professors, of experienced practical mechanics, of engineers skilled in mining and metallurgy, of practical chemists, versed in the processes of the arts; its monthly receipt of the scientific journals of this country and of Europe, and its own monthly journal and review—these are its means of usefulness, and to all these the members of the Institute have free access. If the words of Playfair, Liebig, and Humboldt be true, if our daily experience and if our common sense do not deceive us, a proper use of such means cannot fail to advance the mechanical intellect of our community, and better fit us for the great national conflict, now and hereafter to be witnessed.

To all who are interested in the progress of the arts and manufactures of our country, the eloquent appeal of Sir Humphrey Davy addresses itself with force:

"You have excelled all other people in the products of industry. But why? Because you have assisted industry by science. Do not regard as indifferent what is your true and greatest glory. Except in these respects, in what are you superior to Athens and Rome? Do you carry away from them the palm in literature and the fine arts? Do you not rather glory, and justly, too, in being, in these respects, their imitators? Is it not demonstrated by the nature of your system of public education and by your popular amusements? In what, then, are you their superiors? In everything connected with physical science, with the experimental arts. These are your characteristics. Do not neglect them. You have a Newton, who is the glory, not only of your own country, but of the human race. You have a Bacon, whose precepts may still be attended to with advantage."

We have a Franklin. He trod the path of Bacon and of Newton; he reached the same pre-eminence. Amid his daily toil as a mechanic, he struggled up the steep ascent of science. The labor of his hands abated not the vigor of his intellect.

Loiter not in the path which these great men have opened, lest you be overtaken and vanquished in the strife. Say, rather, that their precepts shall be attended to, and their example followed.

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